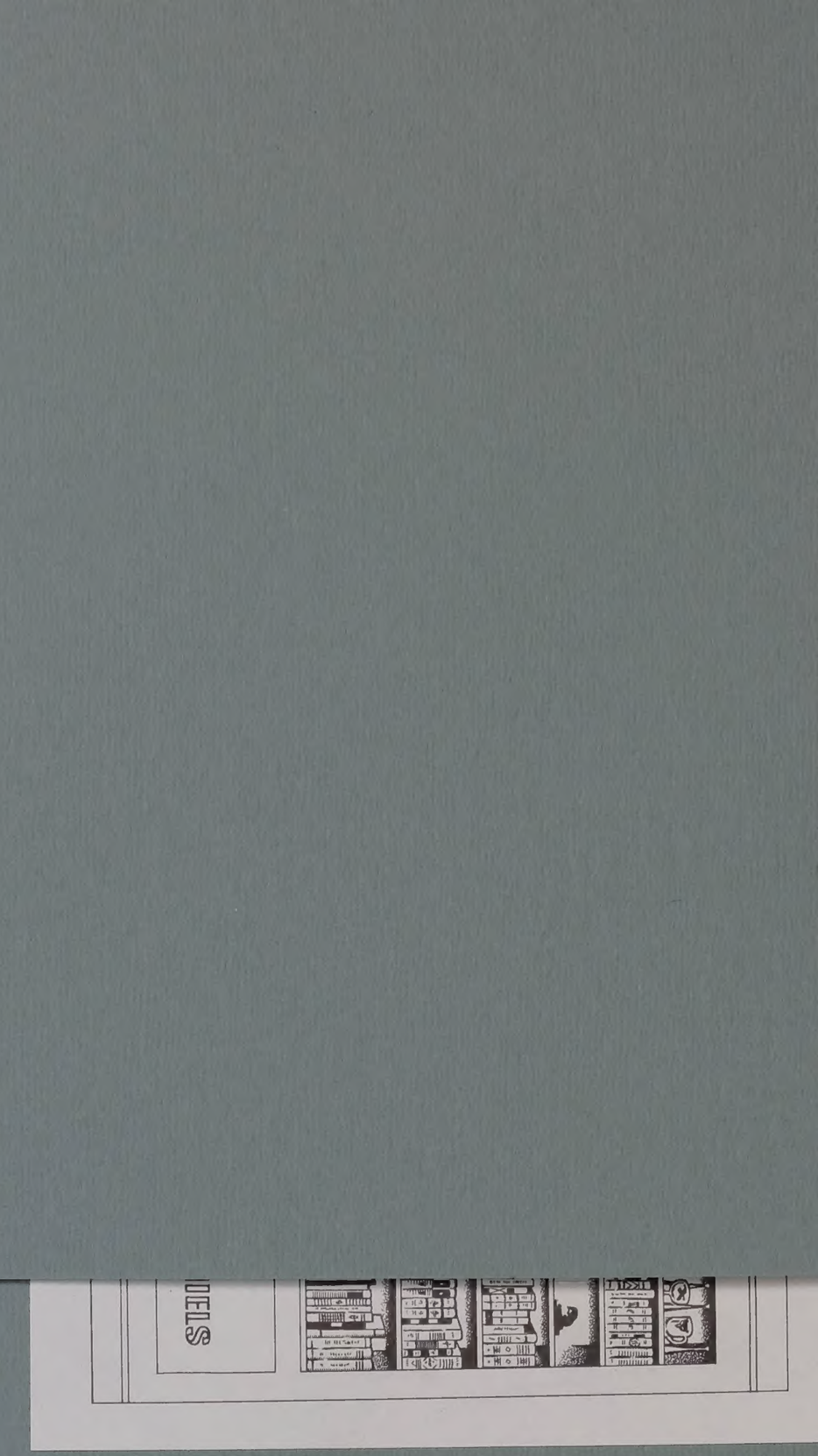


CHUM SALMON

Oncorhynchus keta ♂

SALMON OF THE WORLD

Ernest Schwiebert

Winchester Press

OF AN EDITION LIMITED TO

SEVEN HUNDRED AND FIFTY COPIES,

THIS IS NO. 672

ERNEST SCHWIEBERT

COPYRIGHT © 1970 BY ERNEST SCHWIEBERT
ALL RIGHTS RESERVED

LIBRARY OF CONGRESS CATALOG CARD NUMBER 70-127960

ISBN 0-87691-023-1

PUBLISHED BY WINCHESTER PRESS
460 PARK AVENUE, NEW YORK 10022
PRINTED IN THE UNITED STATES OF AMERICA

FOR SARA

who has waited patiently
while her fly fishing husband
has explored salmon rivers
from Lapland to Patagonia

OF AN EDITION LIMITED TO

SEVEN HUNDRED AND FIFTY COPIES,

THIS IS NO. 672

ERNEST SCHWIEBERT

COPYRIGHT © 1970 BY ERNEST SCHWIEBERT
ALL RIGHTS RESERVED

LIBRARY OF CONGRESS CATALOG CARD NUMBER 70-127960

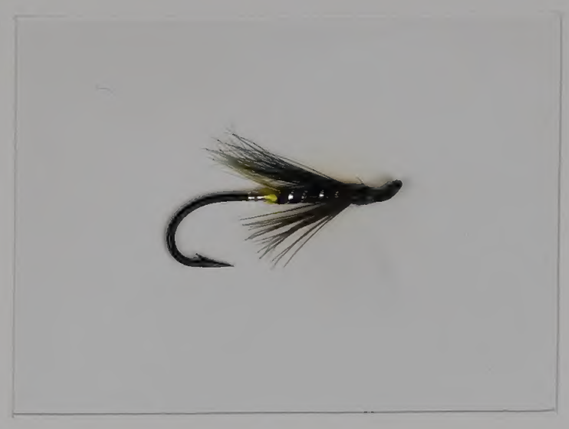
ISBN 0-87691-023-1

PUBLISHED BY WINCHESTER PRESS
460 PARK AVENUE, NEW YORK 10022

PRINTED IN THE UNITED STATES OF AMERICA

FOR SARA

who has waited patiently
while her fly-fishing husband
has explored salmon rivers
from Lapland to Patagonia



SALMON OF THE WORLD

FOREWORD

by Arnold Gingrich

Salmon fishing is one of the few remaining privileges in a demotic era when privilege of every sort is either heavily in discount or already in eclipse. Fittingly it is known as the sport of kings, for like royalty itself the salmon is a steadily diminishing species. In these latter years of the century of the common man, the pursuit of salmon has become, at least by contrast with the burgeoning leisure activities of the exploding population, the least common of sports. It is without question one of the costliest, per minute of action in ratio to total investment, of all participant sports. Certain beats on certain famous rivers now bring as much per week as they brought, within the memory of most of us, per season.

To parallel, in the realm of organized sports, this rarefied position of salmon fishing in that of individual sports, you could hardly find a match short of the hideous cost of contending for the America's Cup. And even that can be amortized over several seasons, whereas it would be a poor salmon fisherman indeed who would be content to wait that long between bouts of his favorite indulgence.

It may seem ludicrous, under the circumstances, to refer to any book on salmon as a bargain, for any book on salmon is almost by definition caviar to the general and of interest and meaning only to the privileged few. But the book in your hands, when scaled to the proportionate costs of seeking the lordly creatures it depicts anywhere outside the confines of an armchair, is a tremendous bargain.

In its thirty drawings alone, it fulfills the promise of its title, *Salmon of the World*. To most of us, this is six or seven times as many as we've ever either seen or heard about. Atlantic salmon and Pacific salmon, sure. Everybody knows the A & P. Then there are the landlocks, of course, and sea trout, including steelheads. But then what? Well, then, better than a score of others, that it would take a young fortune to go see for yourself. And given the time and the money, it would still take a lot of luck, to see so many in anything like this gorgeous close-up of colorful detail.

And as for the text, that's a reverse switch on the title, for it equates quite simply and succinctly to nothing less than *The World of Salmon*. Despite its relative brevity, it is almost encyclopaedic in the breadth of its coverage of the subject, and for those who wish to pursue any of its facets in greater depth, serves as the

most knowledgeable of guides to further study. It's all here, the lore and the lure, the literature and the ecology, the natural science and the romantic appeal, the whole *mystique* of this kingly quarry.

Even without the drawings, this would have been a notable and definitive contribution to the already vast literature of those most written about of fish, the members of the salmonid family. I can think of only four figures of the salmon world who could conceivably have come up with the concise and condensed and compressed intelligence about salmon that this text represents. You could lock Lee Wulff, A. J. McClane, Charles Ritz and Roderick Haig-Brown in one room and not let them out until they had told all they know about salmon in this many words, and you might well have obtained a reasonable equivalent, not to say facsimile, of this text.

But confront them with these drawings and–with the sole exception of Lee Wulff, who would at least be equipped to fight a rear guard action based on his study at Julien's in Paris–the rest could only gawk at them and marvel, even as you and I.

So clearly, Ernest Schwiebert's contribution to the already impressive literature of the salmonids is not only notable and definitive; it is unique.

That it should be so is no wonder, to those who remember that in his student days, with *Matching the Hatch,* he did more for the appreciation and understanding of trout than most authors of fishing books have accomplished in a lifetime. That he should now, in his still young manhood, do as much or more for salmon, would seem to put him into splendid isolation as the Alexander of angling authors.

Unless history lies, Alexander couldn't think of an encore. But don't bet that Ernie Schwiebert can't. Though I'm sure you'll agree, after reading this book, that he doesn't really need one, as with it he has obviously won, incontestably, a secure seat among the mighty in angling's illustrious annals.

INTRODUCTION

Dame Juliana Berners–*"The salmon is the most staytely fysshe that any man may angle to in fressyhe water."*

Almost six centuries have passed since those words were written in the cloisters of Sopewell Nunnery. Dame Juliana compiled the first *Treatyse of Fysshnge With an Angle* early in the fifteenth century. The illuminated manuscript in the Yale University collection was copied at Saint Albans before 1450. Walton crowned the salmon his king of fishes in *The Compleat Angler* in 1653, and there has never been a serious pretender to the throne.

Salmon are still considered the apogee of angling, both because they are readily taken with sporting tackle and their tradition can be traced to Pliny in the first century. Fishing salmon has become both a sport and a pilgrimage.

There are other game fish. Some anglers like sailfish and marlin, riding the tropic seas in expensive power boats with heavy tackle and the skills of the entire crew. Many spend lives in search of giant muskellunge in northern waters, casting their lures into a hundred mist-shrouded mornings. Still others love stalking tidal flats for bonefish and tarpon in small boats, exulting in their strong reel-wearing runs and the threshing power of their acrobatics.

Salmon fishermen acknowledge the excitement of big game fishing off Bimini and Cabo Blanco and Acapulco. They understand the beauty of fishing Chautauqua or the Flambeau Flowage just after daylight, hoping finally to find a trophy muskellunge in the mood. The wild runs of the bonefish at Deep Water Cay and the pole-vaulting tactics of tarpon off Islamorada are an obvious challenge to fishermen everywhere. But salmon fishermen argue that salmon combine power with beauty and a sense of tradition, and that comparing salmon with their muscle-bound cousins is like comparing wrestlers with ballerinas.

There are no written records of salmon fishing before Pliny, although there are countless artifacts of their importance in more primitive civilizations. Cave dwellers in the Pyrenees and the lake dwellers of Neolithic times revered the salmon. Their artisans carved the images of salmon into pieces of antlers and bones. Other people incised petroglyphs of salmon into outcroppings and ledges in northern Europe, and a primordial sculptor carved a hugh cockfish into the ceiling of a sacred chamber in the caverns at Abri du Poisson.

Primitive cultures obviously found overtones of both magic and fertility in the

salmon, and rejoiced in the plenty of their annual migrations from the sea. Pacific tribes believed salmon were symbols of life. Their religions evolved rituals in which the skeletons of the fish were returned whole to the rivers. These offerings were made to insure that the cycle of life would remain unbroken, and the salmon runs would come again.

Salmon were great delicacies in the Roman markets. Centurions fished in the swift rivers of Galicia and Gaul, and other Romans fished for salmon in the rivers of Breton and Normandy. The fish were once caught in the swift river crossings around the island that would ultimately become the Ile de la Cite in Paris. Salmon later graced Roman tables at Trier on the Moselle and the garrison camps of Britain.

Roman fishermen marveled at salmon climbing waterfalls and rapids to spawn, and relished their wild cartwheeling struggle when hooked on their primitive tackle. They searched their language for a name worthy of this noble species of northern Europe–and named them the leapers.

We have little written record of salmon fishing after the fall of Rome, until the *Historia Ecclesiastica Gentis Anglorum* of the Venerable Bede in the eighth century. Bede recorded a wealth of salmon in the British Isles, particularly in Ireland and Wales, and his observations were confirmed in the Domesday Book compiled for William the Conqueror in 1086. Salmon were so important in Norway that a decree issued in 950 by King Haakon I established the boundaries between his maritime and interior provinces at the natural barriers that blocked the spawning runs.

Salmon were also important in France. The knights of the Loire regularly celebrated their jousts with fresh salmon, placed with heads and intestines intact on huge pewter serving platters. Salmon fishermen were so important in the Basque Valley of the Gave d'Ossau that sculptors carved an angler and his trophy above the cathedral portal at Oloron Sainte Marie. Rents from salmon fisheries were a large factor in the powerful fortunes of families like Beaucaire and Rochefoucault.

Salmon were so plentiful in the Rhine that the inns and fish markets from Saint Goarshausen to Lake Constance served rich and exotic dishes in season. The fish were a highlight of the year, and richly prepared salmon were a staple in cities like Mainz and Strassbourg and Freiberg-im-Breisgau. The salmon are gone now, but inns and shops in villages and towns along the river like picturesque Stein-am-Rhein still have their signs celebrating the salmon.

Wales had its riches too. Giraldus Cambriensis described its fisheries in 1188, and Ranulf of Chester recorded a great wealth of salmon in Wales and Britain in his *Polychronicon* of the fourteenth century. Salmon were so important in thirteenth-century Britain that angry nobles included a little-known codicil in the Magna Carta forbidding royal interference in their fishing rights or the spawning migrations.

Laws were written elsewhere to protect the salmon. King Alfonso of Spain published a strong edict against poaching in 1258. King Richard II of England prohibited the netting of salmon smolts and fry, and Henry V forbade traps and weirs in salmon rivers in the years that followed the Battle of Agincourt. Scottish poachers were dis-

ciplined with a stern proclamation of King Robert in 1400, which prescribed death after three offenses for taking fish on their spawning beds.

Explorers like Cabot and Cortereal and Cartier sailed the American coast in the fifteenth and sixteenth centuries. Salmon were so important to Europe that these mariners unfailingly logged the species when they recorded the riches of the New World. Henry Hudson explored his namesake river in 1609, and his mate entered observations of countless salmon jumping and rolling in its tidal currents.

The tradition of sport fishing on salmon rivers began with the Romans, but its written literature had its beginning in fifteenth-century England. Dame Juliana Berners was apparently the prioress of Sopewell Nunnery when she compiled her famous *Treatyse of Fysshynge With an Angle*. It was later included in the *Boke of St. Albans* printed in Westminster by Wynkyn the Worde in 1496, and although there is little mention of salmon fishing, it was the genesis of its literary heritage. Berners described taking salmon between March and Michelmas, using various natural baits and artificial flies in spring and summer. There were woodcuts of hooks and other tackle of the period, and Dame Juliana believed the salmon was without question the ultimate in fresh-water fishing.

Leonard Mascall followed with *The Booke of Fishing* in 1590, although his writing touches only briefly on the sport of salmon fishing, and nothing original is included. Gervase Markham apparently gathered material from everything known about field sports and rural husbandry in his *Booke of the English Husbandman,* which was published in 1614. There is little about salmon fishing except in the following passages:

"Now the salmon hath his haunt in the swiftest and broadest rivers, whose channels fall down to the sea." Like the other writers before him, Markham feared the power of the salmon on the relatively crude tackle of the Elizabethan Age. "Now lastly, as touching the angling for the salmon," he concluded, "albe he is a fish which in truth is unfit for your travaile, both because hee is too hughe and cumbersome, as also in that he naturally delighteth to lie in the bottomes of the great deepe rivers, and as neare as may be in the middest of the channel."

Thomas Barker was the first angling writer to describe the dressing of a salmon pattern in his *Art of Angling* in 1651. This little book was also the first to mention a salmon rod, sixteen feet with a butt of hazelwood, and a winding reel with eighty-odd feet of line. Barker advised his readers that "The salmon swimmeth most commonly in the midst of the river, and in all his travels his desire is to see the uppermost parts, travelling on his journey in the heat of the day he may take a bush," and that there a fish might be taken with enticingly worked baitfish.

Walton's *The Compleat Angler* appeared in 1653, but except for crowning salmon the king of fishes and describing an experiment with tagging smolts, there was little new on salmon fishing. Robert Venables was a regular on Irish salmon rivers, and his skills are evident in *The Experienced Angler* of 1662, which was filled with sound advice to its readers. Venables advised striking slowly, warned that salmon were likely to jump when hooked, and was perhaps first to point out that "Salmon

taketh the artificial flie very well; his flies must be larger than you use for other fish."

Richard Franck was a Cromwellian soldier whose *Northern Memoirs* were published in 1694, and their passages recounted an extended trip through Scotland. Many admirers argue that Franck is the father of modern salmon fishing, and Sir Walter Scott edited an edition of the *Memoirs* in 1821. The book is filled with fishing on the Clyde and the Leven, crossing the interior on a river where he watched salmon building their spawning redds, and sport on the Dee and the classic Spey. It is clear that Franck was fishing flies with considerable technique and refinement. His skills included lowering his rod, cautiously saluting a jumping fish, and allowing it to run when freshly hooked.

Bowlker published his *Art of Angling* in 1746, and the book easily dominated the fishing literature of the eighteenth century. It mentioned brass guides on a salmon rod of eighteen feet and gave dressings for fly patterns. Thomas Best described salmon fishing on the Thames in his *Concise Treatise of the Art of Angling* in 1787. Sir Humphrey Davy added his *Salmonia* in 1828, and George Hansard followed with *Trout and Salmon Fishing in Wales* six years later. John Younger published *River Angling for Salmon and Trout* in 1840, and William Scrope appeared in the classic pages of *Days and Nights of Salmon Fishing in the Tweed* in 1843. Edward Fitzgibbon crowned the first half of the nineteenth century with *The Book of Salmon*.

The first book to publish salmon flies in color should not be forgotten in the cornucopia of books dealing with the sport after 1800. That little masterpiece is the *Fly Fisher's Guide,* published by George Bainbridge in 1816. Bainbridge wrote of five-jointed rods, pliantly flexible and as much as eighteen feet in length. The butts were ash, lancewood, and hickory, and the tips were bamboo canes. Whalebone was used for the final six-odd inches, and the rods were coated with copal varnish. Bainbridge recommended a hundred fifty yards of line, woven from strands of hair and silk. He fished flies in preference to other methods on the rivers of Wales, unlike the writers who preceded him, and his knowledge of salmon fishing is surprisingly valid more than a century later.

Sir Humphrey Davy published *Salmonia* in 1828, and although the book is flawed with factual errors, it also contains some first-rate concepts that remain true today. Davy believed a prime salmon day combined fresh overcast weather with a light breeze, and included some exceptional passages that suggested changing flies to compensate for changing light and depths of water. His theories included the relationship between a rising salmon and its memory of a troutlike existence as a parr, taking aquatic insects as they hatched.

Six years later George Agar Hansard wrote his *Trout and Salmon Fishing in Wales,* which included salmon-fly dressings and sport on the Welsh Dee.

Kirkbride entered salmon-fishing literature in 1837 with his *Northern Angler,* a book that clearly recommends a delayed strike when a salmon comes to the fly to avoid pulling it away from the fish. His advice includes keeping the rod high with a hooked salmon and keeping the dragging slack free of the current, for better control and less danger of fouling on snags and ledges.

Kelso-on-Tweed was the home of John Younger, whose famous *River Angling for Salmon and Trout* appeared in 1840. His classic river is also the home water of the present Duke of Roxburghe, certainly one of the finest salmon anglers of our time. Younger tells us that Irish fly dressings were introduced to Scotland about 1800, and that such bright flies were excellent in high and slightly discolored water. However, Younger preferred the dark feathered patterns evolved on his own water when the river was low and clear, and describes salmon rising like trout to a summer hatch of big *Stenonema* drakes.

Edward Chitty first prepared diagrams of pools and a strategy of fishing them in his *Fly-Fisher's Textbook* in 1841, and included several salmon flies. Blacker followed a year later with his *Art of Angling* and twenty plates of salmon flies in color.

William Scrope assembled one of the masterpieces of salmon-fishing literature in *Days and Nights of Salmon Fishing on the Tweed*. It was published in 1843 and is filled with charming anecdotes and descriptions of his river, unique among books on fishing. Scrope preferred the dark patterns of his native Scotland to the brightly feathered flies that had become fashionable. His rods were eighteen to twenty feet. The book touches on a fishing experience in low water that serves as a prelude to both the greased-line techniques of Arthur Wood and the American dry-fly theories worked out by Colonel Ambrose Monell and his pupils on the Upsalquitch, Edward Ringwood Hewitt and George La Branche. Scrope also believed in changing flies "To adapt my fly, both as to colour and size, to the state of the water: a large fly of sober colours for deep and clear water, and a smaller equally unassuming, where it is shallower; in the throat of the current, and as long as it remains rough, a large fly also; at the tail where the water runs more quietly and evenly, a smaller one serves the purpose best. Thus you should change your fly to suit every stream."

O'Gorman entered the lists in his *The Practice of Fishing* of 1845, which treated Irish rivers like the Shannon and the Erne with the same kind of charm Scrope had brought to his writings about the Tweed two years before. It included a considerable number of fresh ideas about Irish fly dressing and tactics. O'Gorman believed the rod should be held low, both when working the fly and striking a fish, and knew that throwing slack to a salmon threatening to leave a pool would cause a belly in the line below the fish. Feeling a new pressure from below, the salmon would invariably move upstream again. Hatches of natural flies should result in choosing flies of similar color, and O'Gorman concludes on raising a salmon that refuses to take that the angler "should not dog him; three or four casts should determine whether he will take or not. Let him alone, till, in the common phrase, the sun goes back of him."

Perhaps the most famous book on salmon fishing written in the nineteenth century is *The Book of the Salmon,* published by Edward Fitzgibbon in 1850. His work was a compendium of knowledge about salmon from Pliny to his time. It includes an extensive dictionary of fly patterns and several good color plates of flies popular on his favorite rivers. Fitzgibbon reigned as the leading authority among nineteenth-century salmon fishermen until Francis appeared in 1867.

Tolfrey added his *Guide to Norway* in 1848, with eight beautiful plates of sal-

mon flies that indicate the evolution of fly dressing was complete. In 1851 Henry Newland completed *The Erne, its Legends and Fly-Fishing,* which was filled with innovations on flies and fly tying. Both men made significant contributions to salmon techniques, in minor but fully charming books.

Francis was a famous angling editor of the British *Field* whose large *Book on Angling* was published in 1867. His pages were filled with a surprising amount of information about nineteenth-century tackle and tactics on British rivers. Francis preferred a twenty-foot greenheart rod fitted with machined German silver ferrules. His line was oiled silk, and he mentions shooting it to extend his casting distance. The descriptions of Spey casting and other techniques are exceptionally complete. His advice on the rises of salmon is relatively comprehensive, and he describes waiting to strike until either the weight of the fish or a definite pluck is felt.

Spey fly-dressing techniques were added to the repertoire of salmon tactics in *Autumns on the Spey,* a charming book of anecdotes compiled by A. E. Knox in 1872, but it was again the sweeping currents of the Tweed that inspired the next milestone of salmon literature. David Webster emerged with the lively *Angler and the Loop Rod* in 1885, and his brisk style is filled with lucid passages and the poetry of his river. Webster believed in working his flies with the rod, and his understanding of how the mingling currents affected the swing of presentation was sophisticated enough that any modern angler cannot count his education complete without a thorough reading of his book.

Just as Fitzgibbon, Francis, and Webster collated the existing knowledge of salmon tactics, John Traherne contributed his *Habits of the Salmon* in 1889. It included comprehensive treatment of the migration of kelts back to the sea, the spawning habits of the fish, their feeding patterns in fresh water, and the relationship between salmon behavior and the temperatures of the river and the air. Traherne limited his pigskin fly books to a relatively few patterns, and his thinking on the logic of fly selection is still worth reading.

Kelson contributed much to salmon fishing in several books and articles in the last years of the nineteenth century. His book *The Salmon Fly* was filled with important new concepts of tying. His experiments with lines, mending a cast to control fly speed, and more responsive rod actions occupied his career of ninety-odd years along salmon rivers.

Sir Herbert Maxwell wrote *Salmon and Seatrout* in 1898, a book filled with sound theory on salmon flies. There is much good sense about the mythology of local patterns and their alleged magic on their home rivers, and the concept that salmon become selective to specific mixes of materials and colors. Maxwell believed that the drab English and Scottish fly dressings resulted from the relative isolation of their rivers; the bright patterns found in Ireland, with their complex dressings of exotic plumage, he believed were made possible by the proximity of Irish salmon beats to sea commerce and the goods of foreign ports. The book includes the observation that the complex flies were devised to intrigue anglers, rather than the fish, and that their technical com-

plexity was the invention of professional tiers hoping to clothe their art in a hopelessly difficult mystique worthy of a medieval guild.

Lord Grey added his *Fly Fishing* in 1899; its principal contribution was to the philosophy of salmon fishing as a contemplative sport. It was T. E. Pryce-Tannatt and A. H. Chaytor who created the first milestones of salmon fishing in this century. Pryce-Tannatt published *How to Dress Salmon Flies* in 1914, and behind his simple title is the complete book of salmon-fly theory from its genesis in the *Boke of Saint Albans* to the eve of the first World War. Its pages and color plates and diagrams are the *opus magnum* of tying styles and methods on the rivers of the British Isles.

A. H. Chaytor wrote *Letters to a Salmon Fisher's Sons* in 1919, and quickly achieved a place among the major writers on salmon. His book is a summary of prior knowledge and contemporary practice, using simple and effective language. Much traditional theory that did not meet his standards of logic and observation was gently discarded, and we have learned little since his time to prove his judgment unsound. Chaytor was not merely a skilled angler who codified the experience of his generation. His book is filled with original observations from his own extensive experience on the Tyne above Whitberry Ness.

Arthur Hutton fished many years on his Herefordshire Wye, and on Norwegian rivers like the Vossa, Olden, and Rauma. Such wide experience led to several important books. The experiences on the gentle river under the Brixdal Glacier in Nordfjord were recorded in *Reminiscences of Halsten Muri,* the riverkeeper on the pastoral Olden. That little book appeared in 1907, and thirteen years later Hutton published his *Rod Fishing for Salmon on the Wye,* the definitive book on that classic salmon fishery. Hutton was also interested in the ichthyology of salmon, and his *Life History of the Salmon* was a major work that collected the ground-breaking of Russel, Day, Traherne, and Calderwood in the half-century before his book appeared in 1924.

Malloch recorded his lifetime of knowledge on the Scottish Tay in his *Life-History and Habits of the Salmon* in 1910, and W. J. M. Menzies collated his experience as Chief of Scottish Fisheries in *The Salmon: Its Life Story,* which was published in 1925. It stood for almost forty years as the best book of the biology of the salmon, and Menzies added *The Stock of Salmon* in 1949, which surveyed the state of postwar British fisheries.

Eric Taverner completed his book *Salmon Fishing* in 1931, which collected and codified the full body of salmon-fishing theory and technique before its time. Jock Scott recorded the experiments of A. H. E. Wood of Glassel in his *Greased-Line Fishing for Salmon* in 1935, which revealed an entirely new method of fishing salmon invented on the legendary Cairnton beats of the Dee. It was a development as revolutionary as the discovery that salmon would readily take flies.

Richard Waddington advanced his theories on tactics and fly structure in *Salmon Fishing* in 1947. It included a number of original concepts, although some were perhaps based on faulty hypotheses, and its major innovation is perhaps the Waddington style of dressing salmon flies. Its morphology is based upon constructing flies in-the-

round to provide the same silhouette at any angle of vision, and the higher hooking percentages of a treble hook. Subsequent tube-fly theory has conceived similar flies on nylon surgical-tubes, threaded on the leader above a treble hook. Waddington and his theories are the subject of lively controversies at British fishing inns from the Torridge to the Thurso, but there is little doubt that his ideas have stimulated a generation of arguments and new flies.

F. E. Hill continued the experiments begun at Cairnton with his *Greased Line on the Dee, Don and Earn* in 1948. Thomas Phelps recorded his experiences with Mottram and the greased-line method on the classic Laerdal in Norway, and his *Fishing Dreams* is a book that ranges from Hampshire to Sognefjord. Major General R. N. Stewart compiled a lifetime of experience in his *Rivers of Iceland* in 1950, and followed thirteen years later with the larger *Salmon and Trout: Their Habits and Haunts,* which covered the knowledge gained on the rivers of Iceland, the huge Namsen just below the Arctic Circle in Norway, and home rivers in the British Isles. Perhaps the most significant current work to appear in Britain is *The Salmon,* published by J. W. Jones in 1959. It included a lifetime of salmon observations on British rivers, with a summary of information on salmon behavior gathered from scholars in other parts of the world. In its relatively small number of pages is a remarkable compendium of our knowledge of the *Salmonidae,* their habits of spawning, growth, migration, and their Homeric return to the childhood gravel of their parent rivers.

There are surprisingly few books on salmon fishing from the other countries of Europe. French writers include Louis Roule and his *Etude Sur le Saumon* in 1920, Latour and *Le Saumon dans le Courses D'Eau Bretons* published eight years later, and the memorable *Le Saumon Dans le Haut Allier,* written by Henri Boyer in 1930. Perhaps the best French work on salmon is the charming *Fly-Fisher's Life,* which Paris hotelier Charles Ritz completed in 1959. Ritz is a small energetic man who attacks life with a rare passion, and his energies alternate between the elegance of the hotel begun by his father in the Place Vendome and the salmon and trout rivers of the world. His book ranges charmingly from Austria and southern France to Scotland and the Alta in arctic Norway.

Although little writing has appeared from Scandinavia on salmon fishing as a sport, two Norwegian fisheries experts have produced considerable original work on their waters. Knut Dahl finished his *Laks Og Orret* in 1914, and his pupil Magnus Berg completed the books *Laks Og Laksefiske* and *Nord-Norske Lakseselver,* in recent years. Jacob Hafstein is the author of the book *Laxa in Aldaldal,* which records the history and techniques of fishing the most famous salmon river in Iceland, the poetic Laxamyri on the coasts of Pingeyjarsysla.

American salmon-fishing literature probably begins with the logs of explorers who first sailed her waters, and occasional accounts of British officers fishing the Maritime rivers of Canada as early as 1824, but the first book was published in 1860, *Salmon Fishing in Canada* by Sir J. E. Alexander, an English general who emigrated to Canada. The first book written by a native American was *The American Angler's*

Book by Thaddeus Norris of Philadelphia in 1864, and the second was *The American Salmon Fisherman* by Henry Wells in 1886. But the first masterpiece was written by Dean Sage, the wealthy lumber heir whose privately published *Restigouche and Its Salmon Fishing* appeared in a tiny edition of a hundred-odd copies in 1888. It was an impressive, gold-embossed volume printed in Edinburgh, and largely distributed among relatives and friends who fished the Restigouche together. It was the first major book on salmon fishing from American waters, and its Muse is still the classic river of Canada.

The next American work codified the first major innovation in salmon fishing since the genesis of the greased-line method. Contrary to popular mythology, George La Branche was not its inventor, but his *Salmon and the Dry Fly* published in 1924 served as a spokesman for Colonel Ambrose Monell and his experiments on the Upsalquitch. His cantankerous comrade-in-arms was Edward Ringwood Hewitt, whose *Secrets of the Salmon* appeared the following year. Their embellishments of the Monell theories were a fresh wind that opened a whole new world of salmon tactics, and they served Monell much as Frederick Halford was the Boswell for Captain Marryat in the birth of the dry fly.

Their friend and fellow member of the Angler's Club of New York was Gray Griswold, who was the best known pilgrim on the Grand Cascapedia. His experience on its water was recorded in his *Observations on a Salmon River* in 1926, and his *Life History of the Atlantic and Pacific Salmon of Canada* and *Life History of the Salmon* were published soon after. Griswold has filled his work with sound observations, a thorough knowledge of salmon biology, valuable techniques and tactics, and a poetic appreciation of salmon country.

Another friend was Charles Phair, whose lifetime on Canadian rivers was collated into *Atlantic Salmon Fishing,* published in a limited Derrydale edition in 1937. It included watercolors by Ogden Pleissner, numerous photographs of major salmon fisheries, information on dressing effective flies, and a number of maps detailing the rivers in its appendices. It is a large book, generous in its paper and print size and bindings, and its status as a classic on salmon fishing is reflected in its high price on the collectors' market.

Roderick Haig-Brown is the poet laureate of the Campbell and Nimpkish on Vancouver Island, and the literature of fishing the Pacific species perhaps begins with his books. His first was the epic *Silver: The Life Story of an Atlantic Salmon* in 1931. Haig-Brown captured the poetry and tragedy of the Chinook spawning run in his *Return to the River* in 1941, and seven years later he wrote what many consider his best book–the mood in *A River Never Sleeps* is filled with misty autumn mornings in British Columbia, its rivers in cathedral stands of fir and spruce, and concludes with the observation that perhaps men fish because it is their excuse to share the music of their rivers.

Henry Williamson wrote his book *Salar the Salmon* in 1935, and five years later the legendary Lee Wulff began his career of experimenting with salmon on the wilder-

ness rivers of Newfoundland and the Labrador with *Leaping Silver*. His principal work has been *The Atlantic Salmon,* published in 1958, which has made light-tackle salmon fishing the principal method on Canadian rivers. His fly patterns have become standards for dry-fly tactics on salmon. Wulff is perhaps the best fisherman who ever lived in terms of his skill with hooked fish, and his feats with salmon, tuna, marlin, and sailfish on light fly tackle have nearly banished the heavy rods of yesteryear. Fishing with him is like watching a bullfighter like Belmonte or Ordonez work a *corrida* with the odds heavily against him by choice.

William Hagen wrote his *Pacific Salmon* in 1953, and Anthony Netboy added *Salmon of the Pacific Northwest,* followed by his recent *Atlantic Salmon,* which traces the past history and present stocks of salmon fisheries in each country where the species is found. William Harris wrote *Salmon Fishing in Alaska,* but since Haig-Brown the many salmon species that swarm the rivers of the northern Pacific have yet to find a generation of fishermen–like those who fished the classic rivers of Europe –who have a touch of the poet, and will put their rods aside to extend the literature of angling to the rivers they call home.

Such poetry has been caught before, and any summary of the tradition and literature of salmon fishing inevitably leads to curiosity about the fish themselves. The most cursory study of salmon will reveal a fish of great beauty, a life cycle that is filled with mysterious journeys deep in the sea, the will to return unerringly to its birthplace, and the tragic pageant of its spawning ritual. The life of the salmon is an allegory of our lives, and our fascination with the species is understandable. It has led to a literature and tradition of fly-fishing that remains unequaled in any other sport.

That literary tradition is mixed between trout and salmon, and both the ecology and the sporting history of those *Salmonidae* are cut from a single fabric. Most anglers come to salmon fishing after experiences with trout, without losing their fascination for the smaller species.

The Duke of Roxburghe expressed it perfectly over dinner at Joraholmen on the legendary Alta. "Sometimes we hunt tigers," he said, "and sometimes our moods are better suited to grouse."

Although there is something lyric about all of the *Salmonidae,* there is something Homeric about salmon, and it is the mystery of their pelagic migrations that is a primary factor in their mystique and charm. One of the surprising vacuums of this scientific age is our relative ignorance about the oceangoing odysseys of the salmon.

Walton believed with other experts of his century "That eeles growing old, breed other eeles out of the corruption of their own age, which Sir Francis Bacon sayes, exceeds not ten years." Their naivete seems charming, but we know little more about salmon between their departure into salt water and their return to spawn, except for a few feeding grounds that apparently serve as checkpoints during migration.

Our knowledge of salmon ecology is still a fascinating part of salmon fishing. The fish have no fossil history until relatively recent times. The single species known from the Pleistocene Age is smeltlike, and its fossils are only fragmentary. Fos-

sils are known from the lower Ecocene and lower Tertiary periods of western Europe. Ichthyologists argue between two schools of thought on the origins of salmon: that their ancestors have roots in the *Clupeoidei,* or that their genesis lies in the auditory-line and swim-bladder parallels found in the salmon and the Cypriniforms. Most authorities agree that a link to the Cypriniforms is tenuous, and recent studies point to similarities in cranial structure between salmon and the *Clupeoidei,* particularly in the ethmoidal structure of the skull. From these primordial origins, salmon and trout distributed themselves in the northern latitudes. Their distant relatives evolved into coarse warm-water species, and forms that moved into the pelagic depths of the sea.

It is generally agreed that *Salmonidae* achieved their present natural distribution during the Pleistocene Age. The range was partially a result of species migration and partially the effect of glacial cycles in Pleistocene and more recent times. Most authorities are undecided about the precise origins of the salmon, since there is insufficient evidence to pinpoint a common ancestor of fresh-water, marine, or estuarine beginnings. Its complete evolution remains relatively obscure.

Tchernavin argued the fresh-water theory that each genus of the salmon family has a landlocked species, and many salmon ecotypes never migrate to the sea. Most migratory genera in Europe, America, and Asia have landlocked parallels without significant taxonometric variations. His thesis argued further that no salmon bred successfully in the marine environment, and included such detailed information as their migration over obstacles to leave saline waters, their selection of swift well-oxygenated river for spawning, the specific gravity of salmon *ova* is less than salt water and the eggs would float if spawned at sea, artificial fertilization of Atlantic salmon proved impossible in sea water, baby salmon cannot survive high salinity, and many immature salmon develop male sex organs without reaching the sea.

Ichthyologists have learned much about salmon in the thirty years since Tchernavin. Pacific species like *gorbuscha* and *keta* spawn successfully in the brackish currents of their estuaries. Research has proved that the fertility rates of their estuarine beds are comparable to spawning in the rivers themselves, and this new information has only deepened the puzzle: are these fish of estuarine origin, are they still evolving toward river spawning, or are they returning to a marine existence in evolution come full circle?

Whether its common ancestor was found in rivers, estuaries, or the ocean itself, the migratory urge probably caused the salmon's circumpolar range. It is found everywhere that streams and lakes are not completely ice-bound and there is access to the rich northern seas. The southern limits of trout forms are Formosa and Japan, California and Northern Mexico, and Morocco and Afhganistan. The marine environments of these regions are too warm for *Salmonidae* now, but these immigrants probably reached those latitudes in the cooler seas that resulted from the melting glaciers of the Ice Age.

Most biologists agree that the salmon and trout of the world can be classified into six ecotypes, plus the genus *Thymallus* for the species of grayling. The genus *Salmo*

encompasses the Atlantic salmon, its several landlocked subspecies in Europe and North America, and many species of trout: the brown trout of Europe and Asia, the rainbow and *mykiss* trout of the Pacific, the golden trout of the Sierras, and the many subspecies cutthroat found from Mexico to Alaska. The lesser genus *Salvelinus* covers the landlocked and seagoing chars of North America, Europe, and Asia, including the brook trout native from Georgia to the Labrador. *Oncorhynchus* is the classification of the Pacific salmon species, except for *Salmo peshinensis,* the small Okhotsk salmon. The ancient rivers draining into the Black Sea hold the prototypical landlocked species of the genus *Hucho,* and since its discovery we have classified others of the genus from Siberia, Manchuria, and Japan. The two atypical genera are apparently related to the grayling: they include the *Salmothymus* in the mountains of Macedonia, and the larger *Brachymystax* of Siberia and Manchuria–the so-called Baikal salmon.

There are examples of anadromous behavior of each of these genera in some part of the world, except for the three genera–as far as the data indicates thus far–which include the Macedonian trout, the *Brachymystax* salmon of Asia, and the many species of grayling that throng northern rivers from Montana and Dalmatia and Mongolia to the Arctic Sea.

With some variations, the life cycle of the several *euryhaline* species of salmon is similar wherever salmon are found. It begins in the swift shallows of streams, flowing pure and filled with oxygen over clean beds of pea-gravel.

Spawning can occur at a relatively wide variation in times, depending on the latitude of a river and the temperature of its offshore currents. Generally speaking, Atlantic salmon and their landlocked subspecies spawn in the fall and early winter. Landlocks imported to the rivers of Patagonia drop back into their rivers in February and March, and spawn in late May and June in the opposite season below the equator. Similar patterns are seen for both Atlantic and Pacific species transplanted into the southern rivers of the Antipodes.

The members of the genus *Hucho* are spring spawners. Its Danubian species oviposits its eggs in early spring, the Siberian strains deposit their *ova* in late winter, and the Asian species spawn in March and April. Fish of the genus *Brachymystax* are spring spawners, and the Siberian species numerous in Lake Baikal enters its tributary rivers in April to spawn in June.

There is considerable variation in the Pacific species. Humpbacks spawn in late summer, and Calico salmon follow about a month later. Sockeyes lay their eggs anywhere between October and December. Chinooks spawn in two cycles: the first can vary between June and August, and the second cycle may lie from July to December, depending on the river. Cherry salmon can spawn anytime between October and November, and the Coho lays its eggs as late as February.

The female salmon is a meticulous mother. She rolls and turns in the current, displacing gravel slowly with strong undulations of her body. It may take several days and nights of digging and resting before the redd is complete. Her hook-jawed mate seldom helps, except to drive away intruders that might eat the eggs. The redd can

vary from four inches to twelve inches in depth, depending on the size of the mother. There is an ample flow of oxygenated water through the gravel of the nest, and once covered with gravel, the eggs are relatively safe from most predators.

During the spawning rites, the water is approximately twelve inches in depth. The best velocity of water is about ten to eighteen inches per second at the surface, and observations by British research teams on Atlantic salmon indicate that the species will refuse to spawn in current speeds under two to three inches per second. The fish exhibit a tendency to jump at all times during the spawning run. The explanation commonly heard from the Alta in Norway to the Katmai in Alaska is that the fish leap to rid themselves of sea lice, an argument that erodes under logic. It seems unlikely that the fish should suddenly be upset by the sea lice after years at sea without any apparent discomfort. The premise seems even less likely when confronted with the fact that sea lice are unable to make the *euryhaline* transition to the rivers, and commonly drop off by themselves after about forty-eight hours in fresh water.

It seems more plausible that salmon jump because of the restless energy packed into their sea-armored muscles, and that practice jumping is the method nature uses to ready the fish for traversing waterfalls and rapids, much as human athletes use calisthenics to train their bodies.

Fish behavior during spawning follows a ritual dance of the rivers. Much time is spent resting at either end of the spawning redds. Sometimes the fish porpoise and jump even when they have reached spawning gravel. Dominant males often push and slide against a female, or turn and bully an interloper off the nesting area. The bedcutting continues, and as it nears completion, the cockfish joins the female more and more until the actual spawning begins.

Sometimes other females try to occupy the nest, but are rarely successful in displacing its builder. During the final hours of cutting her redd, the henfish uses her ventral and anal fins as a gauge to measure its depth. Finally the nest is ready and the female lies deep in its depression. When she finally begins gasping and working her jaws, the male moves in beside the female. Her efforts have shaped the surfaces of the nest so well that the currents inside are considerably reduced, and perfect to receive the ova and milt.

When the male joins the ripe henfish, he also begins to shudder and work his extended jaws. The pale eggs begin flowing and dropping from the female, sliding into the nest past their ragged fins, and the cockfish gasps and extrudes his cloud of milt into the nest. Other males sometimes dart into the redd and pass additional milt as the first orgasm subsides, exercising the natural method of insuring fertilization of the prime female. Predators of other species also take advantage of the moment to gobble luckless eggs that have drifted below the spawning area.

Once spawning has subsided momentarily, the male moves away to protect the nest, and the female moves upstream from the exposed mixture of eggs and milt. That mixture has settled among the stones, and is protected when the female begins rolling above the bottom again, sifting gravel downstream to cover her nest. Her covering

efforts begin the next spawning act, since she continues her work to build a fresh redd. Big salmon may build and fertilize as many as six to eight redds, each slightly farther upstream in the current.

Incubation varies within the several species, depending on the latitude and temperature of the parent river. The pearl-like eggs lie deep in the gravel. Atlantic salmon eggs can range from ninety to one hundred eighty days across their distribution from Spain to arctic Norway. Calico salmon take between one hundred and one hundred twenty days. Sockeyes can vary from three to four months, and Chinooks are similar. Coho and Cherry salmon can require one hundred to one hundred fifteen days.

Upon hatching, the tiny salmon *alevins* wriggle up through the stones. These fingerlings are only a half-inch and extremely vulnerable to predators. The pale yolk sac attached to their bellies is clumsy, and the tiny fish hide and tumble for several weeks among the rocks. The yolk sacs sustain them in this embryonic state for about a month, and finally they venture out into the river.

During this period, the delicate little *alevins* are highly sensitive to light. Like nymphs among the stones, they instinctively move away from it and seek the shelter of darkness. When the yolk sac is exhausted, there is a brief period when they are strongly attracted to the light, drawing them up into open river. Once the tiny salmon fry are swimming free, they once again turn to shelter and shade, and they select the patterns of the current as their lodestone.

Salmon fry are gregarious, unlike tiny trout fingerlings, and remain in tiny schools. When they first emerge, the young fish are scaleless. Scales and tiny parr markings appear when they reach an inch and a half.

It is a cruel and frightening world. Sudden spates that scour the bottom, drought, and changes of temperature in bright weather can all prove fatal that first summer. Winter brings collapsing snowbanks and anchor ice and frozen snow-covered pools with dwindling oxygen. Aquatic predators include trout, sculpins, grayling, pike, yearling salmon, perch, char, eels, chubs, squawfish, and other coarse species that take their toll, in addition to carniverous beetle larvae, dragonflies, and stonefly nymphs among the rocks. Snakes and otters, water shrews and other predators join the feast. Winged enemies like herons, kingfishers, ospreys, gulls, dabchicks, mergansers, and other fish-eating ducks are a menace. Mortality can run so high in sockeye eggs that three thousand fertile *ova* may result in only thirty fingerlings. It is estimated that less than two percent of each egg count survives to reach the sea.

Fingerling salmon of the pink and chum species migrate directly to the sea. Other species remain in the lakes and rivers of their birth for more than a year, growing as much as five to twelve inches before dropping downstream to salt water. Chinook salmon parr have mixed habits. Some migrate downstream to the sea in the first twenty days, while others remain in the river as much as two years. Coho salmon have two-year parr, and the Japanese masu lives in its parent river about a year. Atlantic salmon parr vary widely in the length of their early fresh-water lives. British salmon range from one to three years, but fish in arctic Europe have a riverine parr life lasting as much as four to eight years.

Their feeding begins with zooplankton and diatomaceous organisms. Soon they compete with the river trout for aquatic insects and other tiny baitfish. The feeding rate increases steadily as the parr and smolts migrate nearer to the sea, dropping inexorably toward adulthood.

Salmon parr are remarkably sensitive to temperature increases, and apparently have more fragile resistance to thermal stress than trout. Atlantic salmon will die when their habitat exceeds 32 degrees Centigrade. Pacific salmon are even less tolerant of temperature increases, except for *Oncorhynchous masu,* and their lethal temperatures vary from 23.8 and 25.1 degrees Centigrade. Weeks before they reach the sea, the salmon parr go through a remarkable transformation in color: they become the coin-bright silver of adulthood long before they reach salt water and the beginning of their odyssey. Their downstream migration is recorded in the old couplet:

"The first spate in May, takes the smolts away."

Signs of that migration appear in late winter, when the delicate parr markings disappear and the first hint of silvery guanine flushes the scales. It is already present in minuscule quantities in the epidermis by late winter, and in much larger quantities as early as April. The guanine is apparently an excretory substance indicative of the major physiological changes at work in the fish, changes that will permit them to pass into salt water without problems.

Experiments have shown that the silvery chainmail of the smolts is triggered by their sexual maturity, and the genesis of their eggs and sperm during their downstream migration, but these are not the only causes. Thyroid is apparently another factor, but experiments with anti-thyroids indicate that the silvering process continues with thyroid activity depressed. We still lack the key to this puzzle, but perhaps it is enough for anglers to know that the smolts have clothed themselves in their protective armor of salt water long before they have tasted the sea–another of the secrets of the salmon.

Their ability to enter salt water is still another mystery of all anadromous species, and British studies indicate that the smolts lose water content and weight when they leave the river. The weight loss stops after about a week, and the fish quickly begin growing again. Without some means of controlling salt content, the smolts might reach fatal chloride concentrations in their slender bodies. There are apparently two mechanisms the smolts can use to eliminate salt. Special cells in the gills pass both sodium and chloride ions into the water, and are thought to play a major role in smolt acclimatization to the marine environment.

Migration of the smolts begins the greatest mystery in the ecology of the salmon. They move toward the sea in shoals numbering in the thousands, feeding voraciously as they travel the rivers. Fishermen find them a nuisance, since they are rising everywhere and often snatch at flies before the adult fish can respond. The behavior of Pacific smolts is similar. Giant schools are formed and move into the main currents of the river. There are interesting patterns of ebb and flow in territorial behavior between fry and smolts. Coho fry demonstrate strong territorial behavior but suddenly tolerate greater densities of schooling once they become smolts.

Since Pink and Chum salmon migrate rapidly to salt water upon birth, and inhabit the brackish waters of their estuaries in their first weeks of life, they do not pass through the typical transformation of smolts. Their numbers are almost unbelievable. Salmon monitors in Alaska have observed Pink salmon smolts passing their checkpoints in numbers of 750,000 per day for more than two months. Growth is almost explosive. The sea is apparently a powerful stimulus. Francis found in 1879 that young salmon began feeding at five times their normal rate of ingestion when sea water was gradually introduced into their pens.

Once salmon leave the rivers and their estuaries, we know almost nothing of their life in the sea. Some fish remain within about fifty miles of their rivers, and are more or less under estuarine influences, but our knowledge of the pelagic migration into open seas from most rivers is so minimal that our ignorance causes overtones of a salmon mystique.

Research has given us some benchmarks. The fish disappear almost completely into the sea, but we have enough evidence from tracking experiments and deep-water commercial catches to discover some of the milestones in their migrations. Pink salmon from Siberia travel looping patterns south along the Kuriles, riding the Japanese Current deep into the Pacific, and threading their way back through the Aleutians on a journey of about five thousand miles. Alaskan Sockeyes travel six thousand miles in three years of migration on the cold currents of the Bering Strait, down the Siberian coast to join the Japanese Current, riding it east toward British Columbia, and back in its coastal eddies through the Aleutians to Bristol Bay. The giant Chinook salmon from the Columbia journey the eddy patterns of the Japanese Current north along the broken coast of British Columbia and Alaska. Their trips vary between one year for grilse to four years for prime adults. The four-year odyssey can cover five thousand miles past the Katmai and Kodiak, along the Aleutian chain to return on the easterly currents from Japan. Chum salmon vary in their marine habits. Summer fish from the sea of Okhotsk have their principal feeding grounds inside the Kurile Islands, while the fall run passes the Kuriles and makes a thousand-mile circle into the Bering Sea. Coho salmon are largely coastal species, never wandering far from their home rivers. Shoals of feeding Coho in Sea of Okhotsk below the rivers of Kamchatka, or the schooled fish of Discovery Passage off Vancouver, are typical of the species. The smaller Japanese masu are roughly equivalent in their marine habits.

Similar patterns are apparent among the Atlantic salmon from European and Canadian waters. British salmon apparently leave their parent rivers and disappear completely into deep water. Commercial catches off the Faroes and in the Davis Strait off Greenland, which are threatening the species as its stocks presently exist in North America and the United Kingdom, seem to indicate a serpentine journey that uses the current patterns in the North Atlantic. Salmon from the British Isles apparently ride the coastal effects of the Gulf Stream and the ebbing currents of the warmer stream itself swinging north toward Iceland until they intercept the Greenland current below the Denmark Straits. Then they follow the serrated coast of Greenland, gorging on

capelin and crustaceans and herring until they reach the waters off Sukkertoppen. There the fish find rich feeding in the southerly flow of the Labrador Current, drift with it back to its mingling with the Gulf Stream, and then ride the warmer currents home. Their journeys can total as much as two to six thousand miles of wandering in the open and coastal seas.

Scottish and Irish fish seem to spend more time sampling their coastal shallows, but eventually the majority seem to find their way to the rich feeding grounds off Greenland. Spanish and French salmon probably follow similar behavior patterns once they abandon their estuarine regions.

Baltic fish are a riddle not yet fully solved. Smolts from the Swedish rivers appear to migrate in the southwest Baltic, returning home as grilse or remaining in deep water to make the circuit of the southeast coast off Germany and Poland before coming home as adult fish. Smolts tagged in Poland and on the island of Bornholm have been recaptured off the Kemi and Torne rivers in the Gulf of Bothnia. Fish from northern Sweden have been netted off Estonia and Latvia. Apparently salmon use the comparatively small Baltic, and its brackish coastal currents as a kind of giant marine carousel, traveling to the coasts opposite their natal rivers and coming home again. They wander in shoals and small groups, feeding on rich schools of sprats, herring, sand-eels, and sticklebacks until they are ripe to return and spawn in the rivers of home.

Norwegian salmon apparently leave their parent rivers quickly and migrate out through the fjords and coastal skerries. The fish seem to drift north on the dwindling currents of the Gulf Stream along the entire Norwegian coastline. Fish tagged at stations above the Lofoten Islands tended to migrate north on the warm coastal currents until some circle the Barents Sea, and a few actually explore the White Sea off Murmansk. Most fish apparently drift north under the pack ice off Spitzbergen, gorging on the crustaceans that throng arctic waters, and drift south again on the gathering currents of the Greenland Sea. Norwegian salmon probably follow the Greenland Current south until the mingling flows above Iceland split the schools into groups circling east, destined for specific fjords and rivers.

Iceland has apparently suffered little damage from the deep-water fisheries off Greenland and the Faeroes. Its abundant runs of fish seem to indicate that its fish limit themselves to coastal migrations, using the eddying counterclockwise currents around the island to migrate through their feeding grounds.

American and Canadian fish have complex patterns of behavior that apparently involve both estuarine and migratory environments for growth at sea. Netting experiments in the Bay of Fundy indicate that many of the salmon from its rivers remain within fifty miles of home. Some ichthyologists believe that some salmon from the rich Bay de Chaleur also exhibit minority tendencies to remain in coastal waters. Minimal decline in the salmon stocks of rivers draining the Ungava highlands of the Labrador seems to indicate that these fish remain in coastal waters without migrating into the Davis Straits. However, most American and Canadian fish apparently travel north along the shelving depths of the Grand Banks, joining the Gulf Stream in a long cir-

cling odyssey until they can turn with the southerly currents in the Denmark Straits below Angmagssalik. Their feeding in Greenland coastal waters follows the shoreline past Julianhaab into the Davis Straits, and then they can drift south on the Labrador current to parent rivers from Cape Chidley to the recently restocked waters of Maine.

The speed of migration is a wonder of nature. Alm demonstrated in Sweden that smolts entering the Gulf of Bothnia in May had traveled six hundred miles south by October. It is not known if this journey is a direct trip to reach the particularly rich feeding banks near Bornholm, or if this is a leisurely trip with detours and pauses for feeding enroute. Menzies has sampled enough data to conclude that salmon easily migrate as much as sixty miles per day, and his tagging experiments have verified distances of 1,000 miles at twenty-five miles per day. Newfoundland taggings have studied grilse that moved at thirty-two miles a day for almost 800 miles. Many of the fish netted off Greenland have traveled 2,000 miles, and one salmon had migrated 3,000 miles from the Wear at Durham to Upernavik on Baffin Bay.

The trek home from these half-traced migrations is perhaps the greatest of the salmon mysteries, and although we have considerable scientific evidence of the homing instinct that returns most fish to their parent rivers, we know relatively little about the methods salmon use to navigate the trackless seas.

During the last months of their lives, Pacific salmon turn homeward with a remarkably precise schedule. The Sockeyes of Bristol Bay in Alaska follow a timetable so synchronized that fifty million salmon arrive in their estuaries within a brief three-week period. Their gathering comes from half the points of the compass, filtering through the countless shoals and islands of the Aleutians, and yet their biological clocks are so precise that the peak of the run has never varied more than eight days in the past twelve years.

It is perhaps the first stirrings of the spawning urge that start them home, yet some fish arrive at their natal rivers without reaching sexual maturity, and the trigger mechanism that starts them homeward is infinitely more subtle than mere production of fertile eggs and sperm. They instinctively travel their ancient itineraries in the sea, following primordial patterns deep in their morphology, patterns formed in their sensory responses by the journeys of countless ancestors.

We understand more of their homing behavior once they have reached their original coastal seas, but in the open ocean there are few physical benchmarks. There is certainly the bathography of submarine mountains and plateaus and deeps, and the escarpments of coastal shelves and chasms. There are principle pelagic currents, and shifting eddies and reverse currents where they flow past outcroppings of land. Subtle differences in salinity, the trace chemistry of major watersheds, and faint variations in temperature and osmotic pressure are all guideposts for migration. We know that all organisms have internal chronometric senses that affect their behavior, and several biologists have advanced the theory that salmon combine their sensory clock-like rhythms with observation of the sun and stars to set their course in open ocean. The fact that sonar research indicates salmon traveling deep in the bright daylight hours

and near the surface at night might corroborate the theory of celestial and solar migration.

Since many birds migrate with celestial pathfinding, it is not implausible that salmon might use similar methods of sensory navigation. Other scientists have advanced the theory that the sea may have varying electromagnetic milestones. Ocean currents generate minuscule electrical voltages as their volumetric salinity moves through the magnetic fields of the earth. Some species of eels and fish can detect such minor changes in weak electrical fields. Perhaps salmon possess a similar capacity, and it is possible that their homing in open seas uses all three stimuli: solar, celestial, and electromagnetic clues.

There is also evidence that underwater bathography is a factor in ocean migration. Salmon apparently have staging areas where they gather into schools, like vast armies on the march, and that these landmarks of submarine terrain are perhaps as old as their Pleistocene ancestors.

The Faeroes and Davis Strait and the Lofotens are apparently such rendezvous points in the Atlantic. Port-Aux-Basques on the Cabot Strait is another major benchmark on the southwest Newfoundland coast. Brevik on the Norwegian coast is a staging point for fish from Kristiansand to the Pechora in Russia.

Their return to the rivers of their birth, the so-called theory of parent rivers, is a phenomenon that men have studied since the seventeenth century. Walton described marking smolts with a ribbon in his *Compleat Angler* and recovering them again in their original rivers. Malloch of Perth performed the first scientific studies of the theory in 1905. Marked fish were recovered again from the Tay between 1906 and 1908, although a small percentage was taken in other rivers. The first were forty-two grilse averaging better than six pounds after just over a year at sea. The following summer, fifty-seven mature fish averaging thirteen pounds were killed. The last season, nine marked salmon of about twenty pounds were taken. Malloch proved that most Tay fish corroborate the parent-stream theory.

Once they reach familiar coastal seas, the fish apparently take either a direct route toward their parent estuaries or sort their way slowly along the coastal milestones in complicated seas. British experiments conclude that salmon entering their waters migrate considerable distances along the coast before entering fresh water. This coastal behavior is also typical of Irish salmon. Scottish fish exhibit several distinct migratory habits on their return to coastal waters. Salmon from easterly rivers enter quickly, and salmon moving from the northwest migrate in two distinct groups: those arriving above the Butt of Lewis in the Hebrides swing toward rivers farther east, and those arriving below Barra Head are bound for western Scotland, northern Ireland, and the rivers draining into the Irish Sea. Norwegian salmon have an intriguing characteristic in their returning coastal migration: fish that are taken inside the coastal skerries and belt of islands are close to their parent rivers, and salmon netted outside the coastline are still migrating with a considerable journey ahead.

Pacific research indicates that response to subtle physical and chemical characteris-

tics in the ocean is perhaps a principal method salmon use to sort the intricate clues of coastal waters. Their senses are remarkably sensitive to changes in oxygen, carbon dioxide, and pressure. It is also known that salmon are extremely receptive to subtle changes in salinity. The alkalinity of their blood is delicately adjusted to the carbon dioxide content of the water, and the fish have carbon dioxide sensors in their gill structures. This sensitivity to salinity and carbon dioxide variables could provide another course of guideposts through the labyrinth of coastal current patterns.

Various rivers and coastal areas also have considerable differences in photosynthesis, and thus produce detectable variables in carbon dioxide densities. The precise chemistry of each river is unique as a fingerprint. The salinity of the sea varies with the volume of flow at the mouth of each watershed. Each of these factors also helps a migrating salmon find the unique estuarine fingerprint of his river.

Although most of our knowledge about salmon migrations in open seas is fragmentary, and our hypothesis about their migratory circuits is rather tenuously based upon connecting known sites for pelagic recapture by logical routes of migration, we are on more solid ground once they have re-entered their parent watersheds. They apparently sort through myriad tributaries using their olfactory senses.

Frank Buckland advanced the olfactory theory in his *Natural History of British Fishes* in 1880. Buckland argued convincingly in his book that "Each river has got its own smell; taste or flavour it has hitherto been called, but this I think is a wrong expression, as a salmon's tongue has hooks upon it and is not so sensitive as the tongue of land animals; in fact, it is more an organ of prehension than taste. When the salmon is coming in from the sea, he smells about until he scents his own river."

Buckland was writing about the Atlantic salmon, and there is extensive evidence that his olfactory hypothesis is generally true. However, subsequent tests with the Pacific species have proved them equally sensitive to olfactory stimuli. The odor and chemistry of each river is diluted to tiny traces measured in parts per million, and experiments show that salmon can detect concentrations as minute as one part per billion. Such concentrations are extremely slight. One quart of water washed over a human hand would absorb enough scent that migrating salmon might stop climbing a fish ladder a hundred yards downstream.

Observations on Coho salmon at a fish ladder indicate that only odors associated with danger alarm the migrating fish. During upstream movement at a constant rate, various test materials were introduced to the flow. Such substances as oil, shark repellent, lactic acid, human skin, phenol, bear's paw, sealskin, deer scent, and sea-lion meat were tried. Fifty-four odors were tried, but only human, bear, dog, seal, and sea-lion scent produced a significant change in the rate of migration.

Present theory argues that salmon receive the sensory imprint of their parent rivers during their years as eggs, alevins, fry, fingerlings, parr, and smolts. Biologists believe that imprint is so pervasive it is the built-in compass the fish use to navigate in a watershed itself. Some ichthyologists believe that a similar estuarine fingerprint forms in the time smolts spend in the mouth of the river.

Arthur Hasler collected Coho specimens from a small river near Seattle in an experiment to study olfactory homing. The fish were transported back downstream, and some had their nostrils sealed with cotton and petroleum jelly and wax. The fish had ascended and been collected in separate branches of the river. Coho salmon with open nostrils returned unerringly to their original collection sites, but specimens with sealed nostrils were completely confused and most became lost.

Similar experiments have been performed with Pink salmon and Sockeyes. The studies of Pink salmon in British Columbia and Alaska confirmed a marked tendency in the species to seek its parent river. Cultus Lake studies with Sockeyes, as well as restoration experiments on the Fraser watershed, indicate that parent-stream theory applies to *Oncorhynchous nerka* too. Chinook experiments on the Columbia demonstrated that homing instincts to their parent river were clearly present in the ecotypes used in the studies. Perhaps the most remarkable and amusing example of homing instinct was a Sockeye female that entered its parent river, found the correct major tributary, located the right creek draining the hatchery where it was grown, penetrated the ditch outlet of the hatchery, and was finally frustrated by the three-inch pipe that led to the trough where its egg was hatched.

Migration inland is another odyssey for the fish that have already survived the perils of the sea. Pink and Chum salmon spawn close to the mouth of the river, even in its tidal shallows and estuarine currents, and for them the Herculean ordeal is ended. Other fish must still travel hundreds of miles through fierce rapids and climb waterfalls. Atlantic salmon in the vast George watershed journey almost four hundred miles, deep into the watery heart of the Labrador. Its fish still have sea lice fifty miles above tidewater, where they stop to traverse the four miles of tumbling chutes at Helen Falls. Chinooks travel as much as two thousand miles inland in the Yukon, after as much as five thousand miles at sea.

The salmon enter the rivers in prime condition, their flesh bright with the cartenoids of crustaceans in their diet, and oily fat from gorging themselves on alewives and sand eels and herring. Once acclimated to fresh water, salmon stop ingesting food completely and metabolic changes atrophy their digestive tracts. Their sexual organs ripen during migration upstream, the males heavy with milt and females rich with eggs. The cockfish develops the elongated jaw structure and the cartilaginous hookbill typical of his kind. The skin becomes thick and its scales are deeply embedded. Growth has completely stopped, and the atrophic erosion of the scales will leave evidence of spawning as clear as the drought markings in a tree.

Muscle protein and fat are reduced as much as seventy percent to develop the sex organs. The ovaries are ripe with eggs, which fill the entire female cavity, and the testes of the male are a pair of milt sacs the full length of its abdomen.

The ultimate mystery of the salmon is perhaps that riddle of its behavior that makes it possible to catch them, since they cannot digest food once they enter the rivers and ripen, and most salmon fast entirely in fresh water. Some fish still ingest food just after moving up from tidewater, since a jumping fish sometimes disgorges

food or excretes the contents of its system in its bolting panic upon being hooked. However, the fact remains that salmon are fasting in the rivers and the reason they take our flies remains a mystery. Unlike trout, getting them to rise is not a matter of imitating their food.

There are almost as many theories as fishermen. Some argue that they take flies because they remember their troutlike years as parr in the rivers. The theory is supported by the fact that salmon occasionally rise to hatches of aquatic insects, although this may be triggered by the competitive feeding of trout and baby salmon around them. The old belief that salmon take food and squeeze the juices out without ingesting it is pure nonsense. Some fishermen think that salmon rise to flies or strike a lure to defend their holding-lies, yet they will take long before they reach the spawning grounds and are required to protect the territory of their nests. Part of this territoriality theory is the belief that salmon strike in anger, yet they often take more gently than a small trout, and anger in a fish so powerful should result in infinitely more savage rises.

Many experienced anglers believe that a salmon rises because it has simply not lost the habit of taking food just because it has stopped digesting it. Curiosity is another possible cause. Lacking hands or claws to examine an intriguing object in the river, trailing a stream of tiny bubbles and glittering with bright highlights from its tinsel and hackles, the salmon can only sample it with his jaws. The reason *why* salmon take flies, however intriguing and elusive, seems relatively unimportant beside the exciting fact that they *do* take them.

"But who cares why they rise," laughed the old riverkeeper on the Laxamyri in Iceland, "because we all *know* they rise!"

Spawning time finds them preoccupied with reproduction. Summer drifts into autumn and yellow leaves filter like confetti into the streams. The salmon are dark and have lost the bright sea armor of salt water. Some species arrive over the spawning gravel lacerated and discolored with fungus. Others are marked with seal bites and the wounds of net meshes on their bodies.

The tragedy ends in death for all the Pacific species, except for an occasional Chinook female that lives to drift back into the sea. The fish are mortally exhausted from egg-laying. Most female Atlantic salmon return to salt water as spent kelts, and occasional cockfish also survive spawning, but male mortality runs high. The spawning rites of the salmon begin in this somber mood, with new life literally coming from a ritual of death.

Roderick Haig-Brown eloquently ends his *Return to the River* with the death of his henfish, the big Chinook whose life he has followed from birth:

> The strong current caught her as she went down from the surface. It drew her to itself, rolled her over and swept her on and she no longer resisted. Her tail moved once or twice, feebly, but all the urgencies, all the desires that had driven life through her were spent. So she lay quietly across the stream flow, drifting, as no strong salmon does; and the water opened her gill plates and forced under them, and she died.

And so the ancient pageant of life goes on, and the rhythms of the river tell us Eliot was right in his *Waste Land,* because April is a cruel month when salmon hatch and their *alevins* wriggle out through the gravel. The river has a rebirth we cannot share in its primordial cycle of life.

Old friends who fished past rivers from Patagonia to the Valley of Ten Thousand Smokes in Alaska are missing. Men who shared the sweeping pools of the Miramichi and the tumbling wilderness rivers of the Labrador are gone. There are empty places at supper in the farmstead on the Driva and in the Victorian scrollwork hotel at Laerdalsoyri.

Skilled fishermen like Larry Koller are dead, although his beautiful *Treasury of Angling* remains. His ashes have drifted deep into the Neversink, and his flies will never again work the schooling Sockeyes in Alaska. John Randolph will never file another wry column on the habits of salmon fishermen for *The New York Times,* and friends buried him on a birch-covered hill above his house in Massachusetts. The artist Jack Atherton died fighting a salmon, and no longer fishes the Miramichi on the bright mornings of September. His friends savor his little book *The Fly and the Fish* on winter evenings, and remember the Battenkill funeral.

We can never forget the death of the poet Steingrimur Baldvinsson on his river in Iceland, and the twilight he lay dying in the grass. There have been later pilgrimages to his river since, and there is no trace of the poet in the wildflowers above the pool where he died. Many times we have heard that we cannot take anything with us, but it was never true. Life is always there, all of it, everything we have heard or tasted or experienced. Our missing friends and the timeless regeneration of the river only remind us of our own mortality. But the moods of salmon fishing are scarcely elegaic, and there is laughter in the tumbling music of the rivers.

The mind returns to memories of mornings on the Dee, with the mists layered across the highland forests, and the moors along the Thurso in the August twilight. It remembers salmon rolling in the castle beats of the Ballynahinch in Ireland and cold April mornings on the Torridge. There are still coracles drift fishing on the Teifi in Wales, and late summer is the time to fish the Derwent in the hills of Cumberland. There are March memories of Huchen fishing on the Isar below Munich, and in the headwaters of the Iller at Oberstdorf with the Nebelhorn lift still crowded with skiers. The tea-colored Kemi tumbles down to the Gulf of Bothnia through dark Finnish forests, and there are salmon still running in the Morrum, farther south in the churchyard landscapes of Sweden.

It is still raining in the mind, remembering that first morning on the fierce rapids of the George, deep in the wilderness of the Labrador, and the numberless grilse rolling in the tidal shallows off the Adlatok. The canoe drifts down the dark currents of the Humber in Newfoundland, and the winged shadow of a floatplane touches the River of Ponds. Big summer henfish lie resting in the smooth currents of the Matane, and shoals of bright twelve-pounders migrate upstream along the Miramichi and pastoral Margaree.

Countless salmon still gather below the falls on the Brooks River, and the swift Iliamna is filled with its rolling cherry-colored Sockeyes. Giant Chinooks lie deep in the Sustut and the Kispiox when autumn comes to the wilderness of British Columbia, and there are Coho porpoising in the Campbell and the Nimpkish.

There are exotic places too. Salmon are running in Galicia when oranges and camellias are blooming, and the fishing inns are filled with the soft music of Spanish guitars, and half a world south in February, there are the peso-bright fish transplanted a half-century ago to the swift Traful in Patagonia.

There is more to fishing than salmon. There are many lessons astream, and the thoughtful angler savors them as much as the excitement of a fish.

Norwegian rivers are perhaps the Valhalla of Atlantic salmon fishing, and they have surrendered all of the record fish. They are a storehouse of memories. There is the long twilight of the Midnight Sun, warm on the arctic forests of the Alta, and the quiet creaking of oarlocks is audible above the current as the boatmen maneuver into position along the holding shallows of the Bradstraumen. The deep throated roar of Malangsfossen fills the twilight beyond the gillies warming their hands at fires on its rocky beaches. There is the lacework of countless waterfalls in the valley of the Driva, where fishermen gather around the cellar fire at Storfahle and the salmon lie restlessly in the long tail-shallows of the Gammelholen.

There are other places too, like the crystalline Rauma and its storied Fiva beats once fished by the Prince of Wales. The gentle Olden has a pool named for Kaiser Wilhelm of Germany, the Stryn has a steep-roofed fishing house deep in a cloak of pines, and there is a house above the tidewater falls on the Gaula where the outlines of past salmon are carved in the sitting-porch floor. The tumbling Aroy has its steeplechase of rapids churning through its Platforms of Despair. There are other rivers, like the Vossa and the Suldalslagen, where a sense of history hovers above the twilight pools. There is a sense of poetry on the Flam and in its beautiful Victorian hotel, and the silken Laerdal has its ghosts of royalty and riches, with salmon lying in sea-armored phalanx above its pale bottom.

These are the overtones of salmon fishing: the storied rivers and their casting platforms, their bright currents and moonlight on the glaciers, and twilight lingering above the sea-pools long after midnight, its colors dancing down the dark mountain-walled fjords.

These things we savor in our fishing, in addition to the beauty of the fish themselves. There is the rich tradition and literature of the sport, the muted ballet of lines working in the rain, the bright splash of color and tinsel in our fly boxes, and the lazy porpoise roll and tightening line that spell salmon–and form a prelude to singing reels and fish that pirouette wildly in the sun.

Salmon fishing is the apogee of angling.

CHUM SALMON

Oncorhynchus keta ♂

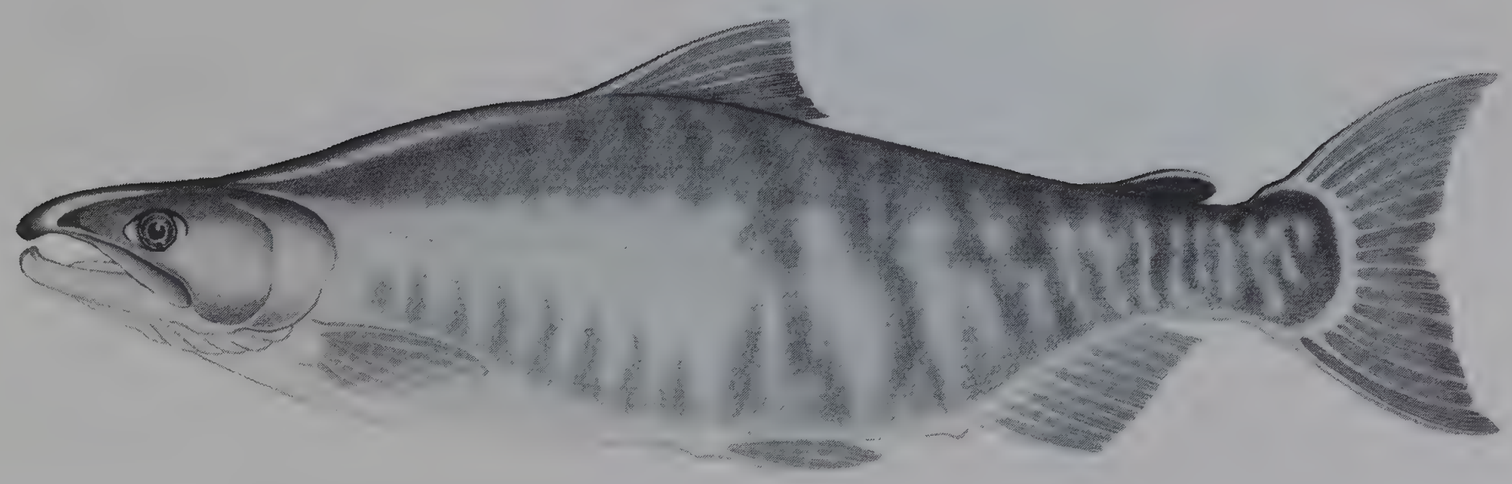


Plate 1

Chum salmon average about eight to ten pounds, although twenty-pound specimens are relatively common. The record fish weighed thirty-six pounds. The species lacks spots on its fins and body and is typically silver until it reaches its home estuary. Brackish waters cause the first traces of spawning colors to appear through the silver of salt water, and the Chum portrait in this portfolio was made from specimens taken in tidal currents of their parent rivers.

The species is identified by its thirteen to fourteen anal rays, some 140-160 pyloric caeca, and nineteen to twenty-six gillrakers. Its feeding is concentrated on crabs and sand eels and herring at sea, and in the river its parr are principally feeders on aquatic insects and baitfish fingerlings.

Annual runs exhibit wide variations in numbers, after four to five years at sea. Since spawning occurs deep in winter, the number of eggs that survive until spring is relatively small. Survival of eggs varies greatly from river to river, and considerable variation occurs between years. These fluctuations stem from several causes. Particularly abundant seasons are self-defeating since school after school of fish arrives on the spawning grounds. Each fresh shoal of fish uproots the redds prepared by earlier arrivals, resulting in extensive egg mortality. Winter drought means low water and frozen gravel, killing countless eggs in the bed of the river. High winter flowages are also important because sufficient oxygenation of the nests is critical, although the cartenoid pigments of the eggs provide some oxygen under difficult conditions.

Chum salmon are most numerous in Alaskan and Siberian waters, although they are found from California to Korea. The species is common in the Amur and Okhota rivers in Siberia and migrates as far as 2,000 miles to Teslin Lake, deep in the headwaters of the Yukon. Although its flesh is pink or pale ocher, lighter than its sister species, it is prized by commercial fishermen. Annual catches are worth as much as fifteen million dollars ranking third in commercial tonnages in the Pacific.

CALICO SALMON

Oncorhynchus keta ♂

Plate 2

Although the species has never been as popular with fishermen as its sister salmon, its strong fight and willingness to strike lures are virtues that might well be explored in the future. Calico salmon are Chum salmon in their spawning colors of dusky orange with purple and olive markings.

The species is found from the Sacramento in California to the Bering Strait, and south along the Asian coast as far as northern Japan and Korea. There are distinct summer and fall runs, and the fertility of the autumn fish is about forty percent greater than the earlier migrants. Summer runs travel only a short distance above the sea. The fall spawners make a more normal migration, traveling a considerable distance in their parent rivers.

Calico salmon commonly assume faint traces of their breeding colors when they reach brackish tidal waters. Their ultimate spawning coat is somewhat like the coloring of baby Calico salmon in the early years of life. During their migration upriver, the Calico will average as much as twenty miles a day, and like its sister species, it will lose considerable weight in fresh water. Marked changes also occur in the structure of the jaws and skull.

Summer migrations occur between July and August. Fall runs last from late August into November. Spawning grounds are in gravelly shallows with a relatively swift current. Summer fish have spent about two years at sea, while their autumn cousins stay three to four seasons in a marine habitat. Calico salmon separate into small groups when they reach the spawning grounds. Several males usually surround a female until one finally ousts its competitors. Redds are typically about a foot deep and five feet in length. Calico eggs are relatively large, measuring as much as five-sixteenths inch in diameter, and spawning often lasts a week. It can occur deep into the winter months, unlike many other species, and Calico eggs can survive extremely cold temperatures. Summer fish and fall spawners in the more southerly rivers often lay their eggs in the brackish tidal areas, and the females typically remain behind to protect their clustered nests.

Calico salmon are easily caught on red-and-white spoons. It was perhaps *Oncorhynchus keta* that caused a British gunboat commander to advise the Admiralty against entering the negotiations for Alaska. *Her Majesty's Government need take no interest in these Alaskan territories,* his message read from the Bering Strait, *because the Alaskan salmon seldom rise to flies.*

SILVER SALMON

Oncorhynchus kisutch ♀

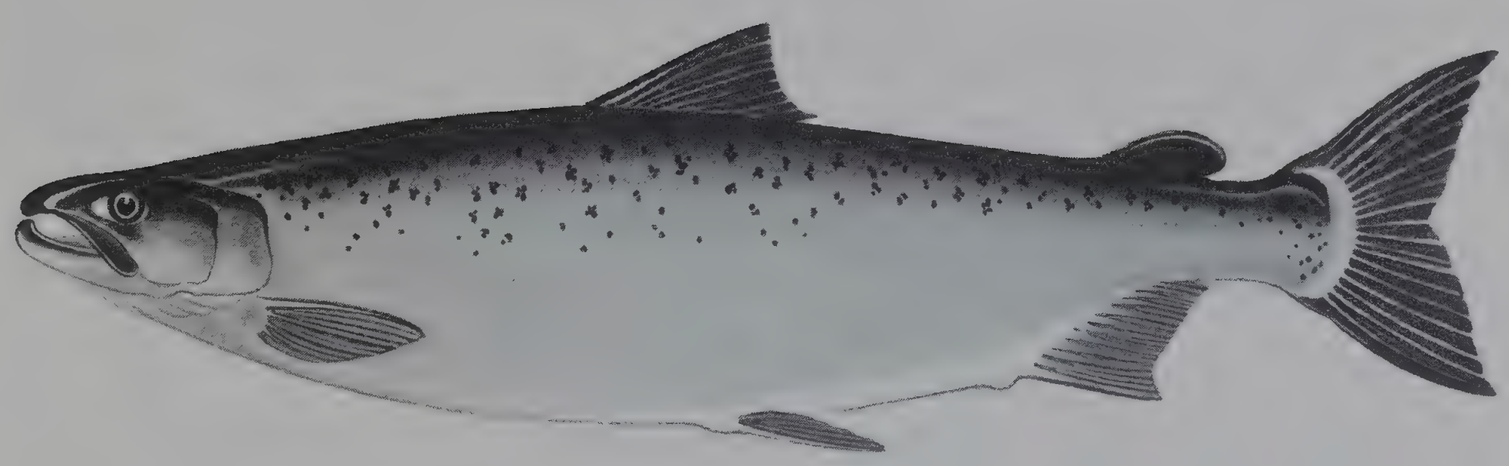


Plate 3

Silvers are considered the best sporting fish among the Pacific species. These salmon commonly travel close to the surface and cartwheel wildly when hooked. Schools of *Oncorhynchus kisutch* are often found working in coastal waters, slashing at shoals of baitfish, and can readily be taken on flies that imitate their food.

Silver salmon have fourteen to seventeen anal rays and nineteen to twenty-five gillrakers. Their principal range lies from northern California to Alaska, although minor populations exist in Asia. The species is found as far south as Hokkaido, but is strangely absent in the southern latitudes of the Sea of Okhotsk. Russian ichthyologists have found very few silvers in the Amur, perhaps the major salmon river of the Siberian Coast.

The species averages four to ten pounds, although the current record is thirty-one. Asian specimens run considerably smaller, and the fish entering the Kamchatka are seldom over three pounds.

Salt-water coloring is pale silver with an olive back. There are distinct spots on the back and flanks, some having cross markings like Atlantic salmon or sea-run brown trout. The fish often have spots on their dorsal fins and tails. The dark tails are strongly forked and graceful. The head structure is distinguished by only two or three tiny teeth on the roof of the mouth, and a white gum line at the base of the teeth.

Oncorhynchus kisutch apparently does not migrate far from its parent river, and in its coastal and estuarine behavior, the species often resembles sea-run trout. It spawns

in both major and minor watersheds. Fisheries experts believe that its ability to propagate in relatively small rivers assures it a major role in future sport fishing, because it is rivers of larger volumes that are most likely to be developed.

Some migratory patterns do exist. Biologists have found that specimens from California rivers are sometimes recovered in Washington. Oregon strains wander from California to British Columbia. Fish spawned in British Columbia apparently travel the coastal waters off Vancouver Island. Salmon from the rivers of Washington range from northern California to the Queen Charlotte Islands. Alaskan strains exhibit a more definite estuarine behavior, and remain primarily in Alaskan waters.

Salt-water fly-fishing for silvers is great sport. Gulls often reveal feeding activity on candlefish and herring, and the periods of peak feeding typically occur with tidal changes. Good sport can last as long as two hours. Perhaps the best fishing is found in the classic rivers of British Columbia and in the mist-shrouded tidal currents of its Discovery Passage.

COHO SALMON

Oncorhynchus kisutch♂

Plate 4

The male coho acquires its reddish sides and olive back as it journeys upstream to spawn. Migrating coho salmon still take flies in fresh water, although perhaps not so readily as they do in brackish tidal channels and estuaries like Cowichan Bay or storied Discovery Passage off Vancouver.

Coho runs often follow the larger chinooks in waters where both species abound, entering Siberian rivers in late July and North American waters as late as October. Roderick Haig-Brown writes in his *Fisherman's Fall* that the Coho peaks after the larger Chinooks, arriving in his beloved Campbell in September.

Spawning in Asian rivers occurs between October and December, although it can last as late as February. Most Cohoes in Canadian and American waters reach their parent gravel in those same months, with peak activity in November. Mature females oviposit an average of 5,000 eggs. Since the species is most common in southerly rivers, its mortality rate of four to five percent of the eggs is relatively low. Incubation lasts one

hundred to one hundred fifteen days. Spawning and hatching are relatively prolonged, and coho *alevins* are still leaving the redds as late as July. Fingerlings and parr remain about a year in the river, feeding first on zooplankton and later on tiny baitfish.

The species is extremely tolerant of marginal spawning conditions. Cohoes are able to spawn successfully almost anywhere, from just above tidewater to hundreds of miles upstream. Coho typically spend three to four years at sea, although some males and a few females return in only two seasons. Their marine diet consists largely of alewives, candlefish, herring, crustaceans, and squid. Crab larvae are a basic factor in the explosive growth of coho smolts.

Coho salmon have been introduced into the Great Lakes in recent years with dramatic success. The species was intended to balance an invasion of salt-water alewives that entered the lakes through the Saint Lawrence Seaway. That ecological problem was preceded by near disaster. Lamprey eels had entered the lakes through the Welland Canal and decimated the native species of trout and char.

The introduction of *Oncorhynchus kisutch* to the Great Lakes region resulted in early migration downstream, vast schools of smolts that gorged on alewives, and returned after only eighteen months averaging ten to twelve pounds.

It is still not certain how the species will stabilize in its new habitat, once the alewives are thinned and their population checked. Some ecologists are worried about the post-spawning death of so many large fish in a short period, given the relatively small size of their new rivers. Fewer predators are available to police the watersheds, like the gulls and fish eagles and bears of their original habitat.

Anglers hope that techniques of fly-fishing Cohoes in the Great Lakes region will be developed in the future. Until then the classic Coho waters remain the tidal currents of the Juan de Fuca Straits, Cowichan Bay, and Discovery Passage, although it is probably the Campbell where the sport reaches its apogee–with poets like Haig-Brown working their flies in the riffling slicks and shallows.

CHINOOK SALMON

Oncorhynchus tshawytscha ♀

This is the principal salmon of the Pacific species, legendary for its fighting qualities since Lewis and Clark fished them on their expedition through the northwest frontier in 1808. The Chinook is the largest species of its family. The biggest known Chinook weighed 126 pounds and was trapped in Alaska, and the current record fish is a ninety-two-pound brute from the Skeena in British Columbia.

The Chinook record was held for many years by the late Frank Steel of Chicago. It was killed on the Umpqua in Oregon and weighed eighty-three pounds. Steel also held the American record in dry-fly tournament casting, and was the master angler who taught me to cast. I can still remember his description of the giant Chinook hooked at

daylight on the Umpqua, and a fight that traveled through a churning rapids and down the length of four pools.

The species is somewhat smaller and less populous in Asian waters, reaching a maximum of about fifty pounds. Its full range lies from the Sacramento in California to the rivers of the Kamchatka Peninsula in Asia, although it is found in infinitely greater numbers in Canadian and American watersheds. Chinooks have been successfully introduced into New Zealand, where they are known as Quinnat salmon.

Chinook fishing is perhaps best in storied waters off Monterey and San Francisco. Sport is also good off rivers like the Rogue and Columbia and Umpqua, with fish arriving in late spring. The fish are summer arrivals in the waters off Vancouver, and trolling off the Campbell is particularly famous.

Plate 5

Fishermen working the tides off the Campbell in August call Chinook above thirty pounds *Tyee* salmon, the ancient Indian name for these giant fish. Those who have taken these giant Chinooks on relatively light trolling tackle have joined a select circle of anglers who know the slashing strike, wild jumps, and reel-searing runs typical of the species.

Chinook salmon have fourteen to seventeen anal rays. Females have small teeth on the roofs of their mouths; such teeth are absent in the males. There are small spots on the back, dorsal fin, adipose, and both lobes of the caudal fin. Mature specimens are full bodied and powerfully muscled with dark coloring at the base of the teeth.

The fish travel long distances at sea, as much as thirty-five hundred miles along the Canadian coast and the Aleutians before returning to their parent rivers in Oregon. Their populations seem most numerous in major rivers like the Columbia and the Yukon. There are distinct runs of spring, summer, and fall Chinook. Spring and summer fish tend to originate in the headwaters and tributaries, while fall Chinook are spawned in the lower reaches of the main watersheds. Hydroelectric projects have all but ended fall runs on many rivers, since their impoundments have eradicated many miles of available spawning areas.

Although relatively unimportant as a commercial species in Asia, with less than seven to twenty thousand centners captured annually, almost twenty-five million pounds of Chinook salmon worth nearly nine million dollars are taken in American and Canadian waters each year. More than a million Chinooks are boated by sportsmen each season in American waters alone.

But it is the swift-running tides of Discovery Passage, moving like the currents of some giant river, where fishing the giant Chinooks reaches its zenith. There members of the Tyee Club gather on their annual pilgrimages to British Columbia, fishing off the mouth of the Campbell. Each has killed Chinooks above thirty pounds, but each dozes in his trolling chair, dreaming of a fish twice that size lying by in the mingling swirls and eddies of the gathering tides.

SALMON OF THE WORLD
page 39

KING SALMON

Oncorhynchus tshawytscha♂

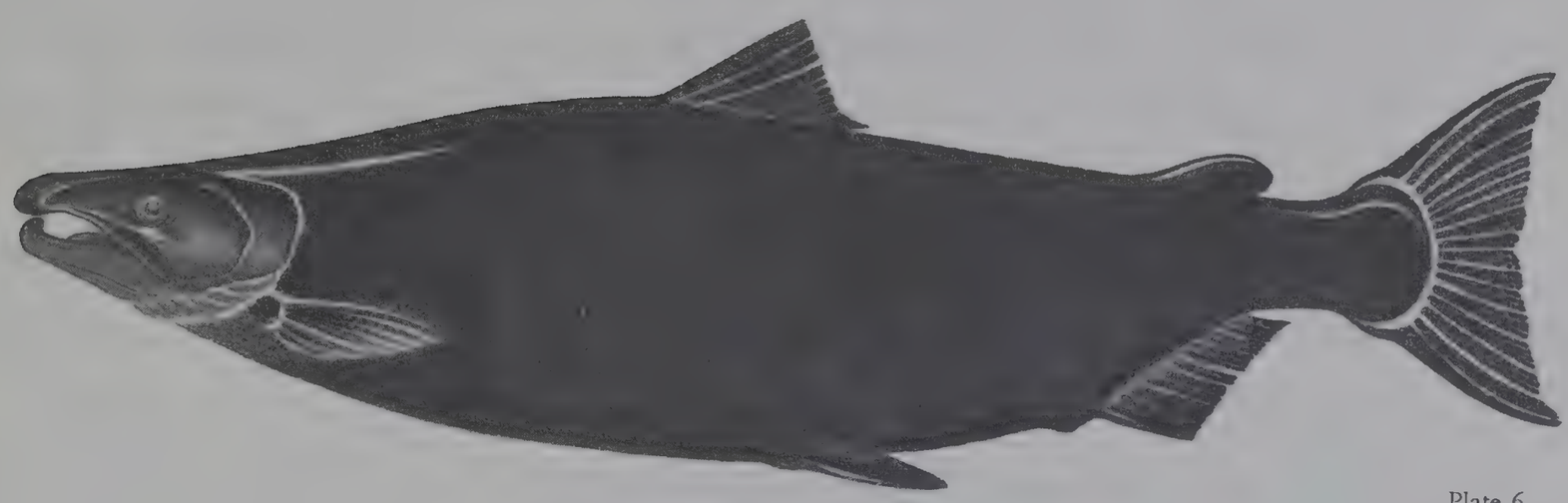


Plate 6

Once they have entered their parent rivers, the females change slowly to a rich brassy coloring and the big males evolve from their sea-armored brightness to deeper colors spangled with huge reddish parr markings. King salmon are almost black when their spawning rites are finished.

King salmon travel vast distances in their home rivers once their ocean odysseys are finished. Fish in the Yukon watershed are known to journey as much as 2,000 miles upriver to spawning grounds deep in the interior.

The species may mature at any time between one and eight years of age. Year-old males ripen before they reach the sea. Most become mature after four to six years. Many young Chinooks migrate almost at once to salt water, while the fall spawners remain in their rivers as much as three to four months. The young of the big spring fish spend more than a year in fresh water.

Females are much less weakened when they reach the spawning areas than other species, and are often full-bodied and bright hundreds of miles above the sea. Some female kelts are known to reach the sea after spawning, although there is no recorded instance of second spawning.

Fish enter the Rogue in April and are found in Siberian rivers a month later. The spawning runs arrive in Canadian rivers late in the summer, and the fish spawn much earlier than the other Pacific species. Spawning can occur late in June on rivers like the Kamchatka and Sacramento. Fecundity of the King salmon is much greater than its sister Pacific species, with as many as 15,000 eggs from a single female, although about 5,000 eggs is more common.

Some fish are taken on big streamers and other flies fished deep in their holding lies, and future experiments with fly tactics appear to hold considerable promise, but King salmon are principally a species taken on plugs and spoons.

It was the skeletons of King salmon that the Kwakiutl and Bella Coola tribes returned in ceremonies to the river, hoping to perpetuate the rich migrations of fish in the rivers below their villages.

Salmon gillies on the Alta in arctic Norway once performed a similar ritual after a banner night at Sautso. It was a misty night with a fine rain that scarcely disturbed the smooth currents. That night three giant salmon came to my bright hairwing Torrish in the Velliniva Pool, fish weighing between thirty-nine and forty-six pounds. When the third salmon was boated, long after midnight in the swift currents below the pool, the gillies reverently examined the fly.

Its hackles were matted and its hairwing was ragged and thinning badly. Two long spirals of loose tinsel wound free of the body, which was dark with worn working silk showing the hook.

The gillie clipped it from the nylon, held it high in the dying light of the midnight sun, and threw it far out into the pool. *It belongs to the river now,* he said solemnly as we shook hands.

PINK SALMON

Oncorhynchus gorbuscha♀

Plate 7

Pink salmon are prized for both their commercial value and their sport-fishing qualities. They are the smallest of the Pacific species, averaging about twenty inches and three pounds in weight. Mature fish of five pounds are relatively common, and Pink salmon above ten pounds are occasionally recorded. Although spoons, spinners, and salmon roe are most typically used to catch the species, increasing numbers of fly-fishermen are finding it excellent sport.

The fish are found from the San Lorenzo in California through the Arctic to Hokkaido and Korea. They are particularly numerous in the Colville watershed that enters the Arctic Ocean from Alaska.

Pink salmon have thirteen to sixteen anal rays and relatively small scales. There

are 170 to 230 scales below the lateral line. The first gill arch has twenty-four to thirty-five rakers. The fish have large blotches on the caudal fin, the forward rays of the dorsal, and the upper back. Coloring in the sea is silvery, like most salmon, with backs of olive to bluish green.

Considerable evidence indicates that Pink salmon migrate in shoals originating in their parent rivers, and that these schools do not migrate as far as the larger Pacific species. The species runs surprisingly uniform in size, depending on the abundance of the spawning year. The more fish spawned and schooling at sea, the smaller the average size; in years of reduced yield from the parent rivers, the salmon are larger. These annual fluctuations in size are more pronounced for *Oncorhynchus gorbuscha* than for other species. It seems possible that maximum growth of each population year is determined by food supplies available in the sea. Growth is extremely rapid and the fish are mature in their second year of life. Marine research indicates that male Pink salmon grow more rapidly than females.

Pink salmon are a major commercial species, accounting for as much as eighteen million dollars per season. Although they are smaller fish, and their total tonnage is typically second to Sockeyes, more Pinks are caught than any other salmon.

The spawning runs arrive during July, gathering in great numbers in the brackish tidal currents, and work in huge schools into the lower rivers. Anglers willing to fish flies imitative of their baitfish diet will find fly-fishing excellent sport when these fish are still relatively fresh from the sea.

HUMPBACK SALMON

Oncorhynchus gorbuscha ♂

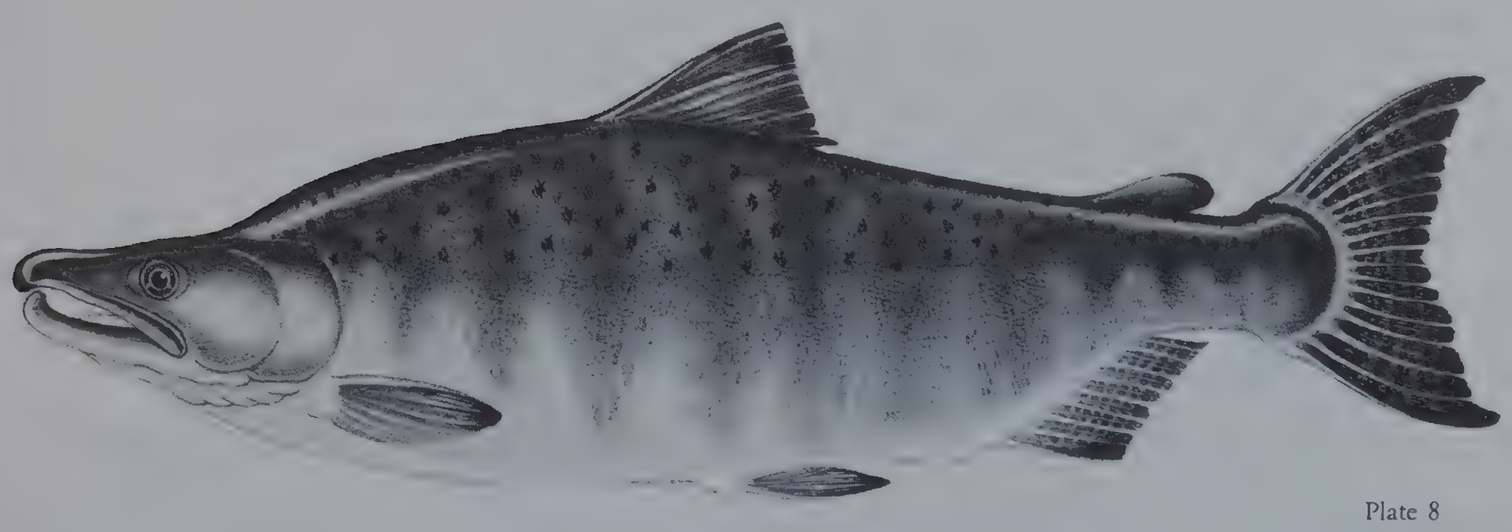


Plate 8

Humpbacks are the mature pink salmon males that have developed the cartilaginous distortions of the skull and upper back, displaying a huge hump ahead of the dorsal fin and greatly enlarged jaw structures. Its breeding colors are quite strong, with strong steel-gray barring on some specimens and fins touched with dull rusty tones. Males are sometimes reddish blotched with olive and brown.

Spawning grounds are usually located much closer to the sea than those of the other species. Migration to those spawning areas is much shorter. Like the Chum

salmon, the Humpback makes its redds in the gravelly channels of the main river, although it favors the increased oxygenation of heavier currents.

The eggs of the Humpback are pale, and the respiratory network of its *alevins* is less developed than those of the Chum salmon. The fish spawning in August and September in Siberia, and are over their redds somewhat earlier in California and Alaska. Fertility is relatively low, with approximately 1,500 eggs per female. The ratio of males to females is remarkably even, and all spent fish die when their spawning rites are finished, like their sister Pacific species.

Mortality of Humpback eggs and fingerlings is surprisingly high, after an incubation of 110 to 130 days. The *alevins* hatch in December and live in the redds until spring. Humpback fingerlings lack the riverine protective coloring of spots and parr markings common in other baby salmon, perhaps because they spend so little time in fresh water before dropping down to the sea.

Studies made in the Iska in Siberia indicate that fifty-eight percent of the eggs are oviposited successfully in the redds. Four percent are alive in the spring. Less than two percent of the Humpback fingerlings live to reach salt water.

Russian ichthyologists have tried to introduce *Oncorhynchus gorbuscha* in the rivers east of north Norway and Finland. Strays have occasionally turned up in the rivers of Finnmark, particularly in the Alta and Repparsfjord and Lakselv. Their small size and humpbacked configuration has the contempt of gillies on the storied Alta, the finest Atlantic salmon river in the world.

Pukkelaks! they grunt with disgust when they see the small humpbacked salmon after a strike. *Pukkelaks!*

MASU

Oncorhynchus masu♀

Plate 9

Most ichthyologists consider the small Masu species quite closely related to the Pacific strains of trout, particularly the *Salmo mykiss* of Asian waters and the familiar rainbow of the Americas. The Masu salmon is found only in Asia, ranging from Korea and Japan to Kamchatka. Its stocks are particularly abundant in Japanese waters, the skerries and islands of the Kuriles, and the Amur Basin of the Siberian coast.

It is the most warmth-loving of all salmon species, and its marine habits are pri-

marily coastal and estuarine in character. Masu range through the waters between Japan and Korea, threading in shoals of feeding salmon through the Kuriles and circling the Sea of Okhotsk in search of crustacea and baitfish. Its migrations end early, the fish entering the Amur late in May and its other rivers throughout the summer. Some subspecies become sexually mature in certain Japanese waters without descending to their marine habitat.

Oncorhynchus masu is a handsome fish averaging about three pounds, with spots on its silvery flanks and olive back. It is little known outside its Asian distribution, except for its relatively small commercial tonnages, although its size and taxonometric similarity to the rainbow trout point to a superb fly-fishing species if its parent rivers were readily accessible to anglers.

CHERRY SALMON

Oncorhynchus masu♂

Plate 10

The Cherry salmon is the spawning form of the Japanese masu, which Asian ichthyologists believe is closely related to the Pacific species of trout. It is also similar in structure to the Coho familiar to American and Canadian anglers. Its coloring is also similar to the Coho in its spawning dress, except for the dark parrlike markings that darken the reddish orange flanks of the Cherry salmon.

Oncorhynchus masu averages about three pounds. It has eleven to fourteen anal rays, between one hundred thirty and one hundred forty scales along the lateral line, eighteen to twenty-two gillrakers, and thirty-five to seventy-six pyloric caeca. Its range includes warmer latitudes than its sister Pacific species, and it has been found from Korea to Kamchatka.

Its fins are orangish and its spotted back is darkly olive above its cherry-colored sides. The dorsal and upper back, as well as the upper areas of the caudal fin, are deep indigo green. The anterior rays of the anal, caudal, pelvic, and pectoral fins are sometimes touched with scarlet. During spawning the reddish sides are flushed with orange and olive. It is a handsome fish.

Like the other salmon ecotypes, the Cherry salmon has occurrences of dwarf males and landlocked subspecies and the incidence of smaller specimens that have access to the sea without choosing to migrate.

KAMCHATKA SALMON

Oncorhynchus kamchatka♂

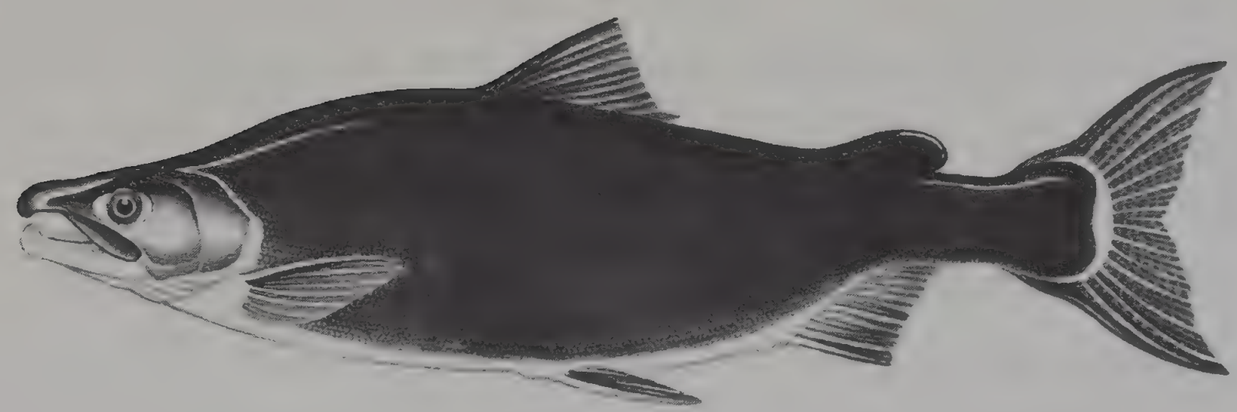


Plate 11

The Kamchatka salmon is a subspecies of Sockeye salmon landlocked in the lakes of eastern Siberia. Its full taxonometric classification is *Oncorhynchus nerka kamchatka,* and it is a dwarf form of its parent anadromous species.

It has thirteen to sixteen anal rays, with nineteen to twenty-two scales above the lateral line and nineteen to twenty-one scales below. They have thirty to forty gillrakers. Its food consists principally of minute *daphnia* and *diaptomus* plankton. The fish are generally mature at three to four years, although populations in different lakes reach maturity at different times. Like the parent species, Kamchatka salmon are silvery in their years of growth and become bright orangish red in their spawning season.

Almost nothing is known of their sporting qualities, although their close morphological relationship to the Kokanee would indicate the Kamchatka salmon are delicious eating, and that tiny wet flies would furnish first-rate sport.

HOKKAIDO SALMON

Oncorhynchus benimasa♂

Like the familiar Kokanee and the lesser known Kamchatka strain, the Hokkaido salmon is a Japanese dwarf species of Sockeye. Morphologically the Sockeye and its landlocked cousins are identical in structure. Its full scientific description is *Oncorhynchus nerka benimasa,* and the subspecies is relatively common in Lake Akani in northern Japan.

Prior to their spawning season, Hokkaido salmon have the silvery flanks and bluish backs typical of the salmon family. During spawning they develop the greenish heads and reddish bodies typical of the larger Sockeyes, although some females have a marked grayish cast. Males develop a distinctly hooked jaw and humped back during spawning, and average about twelve inches in length.

The species has eleven dorsal rays and thirteen to sixteen rays in its anal fin.

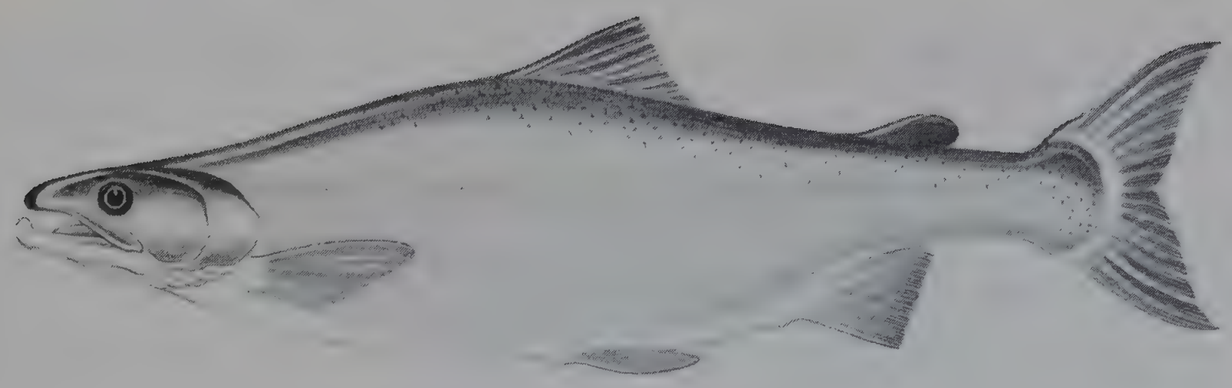


Plate 12

There are 125 to 140 scales along its lateral line. Its foods consist principally of plankton, with *daphnia* and *cyclops* the primary genera. Several populations in Asian lakes feed extensively on copepodal forms of life.

Hokkaido salmon are sometimes called *benimasa* by Japanese fishermen in the northern islands, and although there is little angling pressure, the species is fished commercially along with the troutlike *ayu* found in Japanese waters. Such fishing is exotic, with its torches over the dark waters of the lake and the flocks of tethered comorants that roll and dive to catch fish attracted to the fires.

KOKANEE

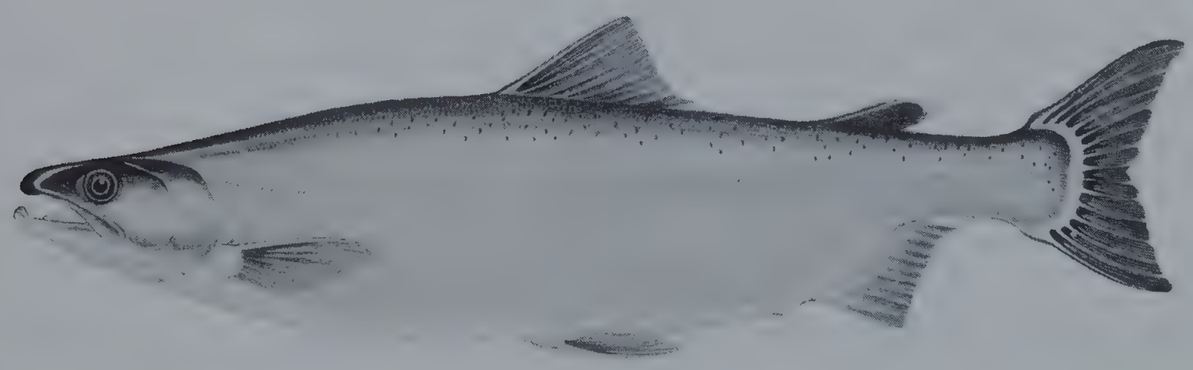
Oncorhynchus kennerlyi ♀

Kokanee salmon are a favorite species wherever they are found, both in their native range from northern Idaho to Alaska, and in the many western lakes where they have been introduced. Like its sister species in Siberia and Japan, the Kokanee is a dwarf form of the anadromous Sockeye. It has become extremely popular as both a sport and table fish.

Taxonometrically the Sockeye and Kokanee are alike. The full nomenclature of the Kokanee is *Oncorhynchus nerka kennerlyi,* and like the bigger species it is silvery with a bluish spotted back before its spawning cycle.

Many anglers confuse Kokanee with trout, although they may be distinguished by their distinctly forked tail and more than twelve rays in the anal fin. Kokanees have thirteen to sixteen anal rays. There are nineteen to twenty-two scales above the lateral line and nineteen to twenty-one below. Their bodies are somewhat more

Plate 13



slender than trout, particularly at the tail, and they have thirty to forty slender gillrakers. The fish are elegant and graceful.

During spawning the males are bright red like the Sockeyes and the females are pewter-colored. Kokanee reach maturity in three to four seasons. Spawning occurs in both lakes and their tributaries, using gravelly areas where currents and wave action provide adequate oxygenation. Plate-sized redds are formed by the females until the depressions in the gravel are two to four inches deep. Oviposition may occur in more than one nest. Spawning in lakes is found in shoals where seepage and wave action aerates the eggs. Like the anadromous species, both male and female Kokanees die after spawning.

Most Kokanee salmon are ten to twelve inches, although in southern British Columbia and Granby Lake in Colorado, they reach fifteen inches. Perhaps the best fly-fishing is at Donner Lake in the Sierras of California, where the Kokanees average eighteen inches and two pounds.

BLUEBACK SALMON

Oncorhynchus nerka♂

Plate 14

Freshrun Sockeyes are called Blueback salmon on most rivers of the Pacific Northwest. It is unlike its sister species in that it is seldom caught by fishermen in salt water, but once its heavy spawning runs reach their parent rivers, Blueback salmon offer excellent sport. Its range is extensive and includes rivers from Hokkaido to southern California, although its presence in rivers below the Columbia and the Sea of Okhotsk is limited, usually consisting of stray individuals and schools.

Weight is remarkably uniform, ranging between five and seven pounds. The record fish weighed fifteen-odd pounds. The species has thirteen to sixteen anal rays, with thirty to forty gillrakers. Its coloring before spawning is bright silver with minute spots on its dark bluish green back.

Bluebacks are the principal commercial species. Fewer Bluebacks than Pink salmon are taken annually, but the bigger *Oncorhynchus nerka* account for as much as 150 million annual pounds worth more than fifty million dollars. They arrive in

vast numbers after as much as 3,000 miles of migratory feeding at sea. Sixty million are found in the Bristol Bay and Fraser watersheds alone, and the fish are prized for the color of their flesh, their rich oil content, and their delicate flavor.

The species arrives in the estuaries of its parent rivers somewhat earlier than its sister salmon. Russian ichthyologists find Bluebacks gathering off the rivers of Kamchatka late in May, and others assemble in Bristol Bay below the mouth of the Brooks River only days later. Most arrivals occur in June and July. Other runs return to the coastal waters off the Anadyr and the Sea of Okhotsk, and below the giant Fraser watershed, in the middle of July. Their relatively uniform size indicates that food supplies in the sea are not subject to the fluctuations that result in wide variations in the size of species like *Oncorhynchus gorbuscha*. The Blueback diet is largely crustaceans, candlefish, and herring.

The late Larry Koller fished and loved the classic Brooks River above Bristol Bay in Alaska, where thousands of Bluebacks gather to jump the falls just above its mouth. Koller described its fast sport one twilight on his Neversink water, with the rich cooking smells of his grouse *cassoulet* drifting through the trees.

It was almost too easy, he laughed, *and finally I stopped fishing and just watched them jumping the falls.*

FEMALE SOCKEYE

Oncorhynchus nerka♀

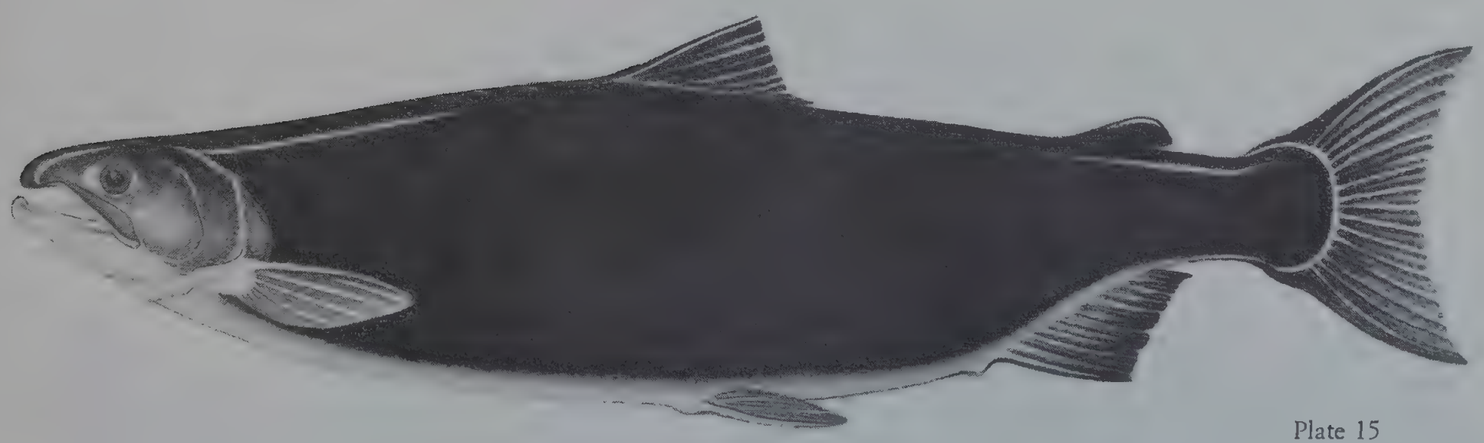


Plate 15

Female Sockeyes are beautiful fish with rich olive tails and heads, and bright reddish-olive bodies and fins. Its principal rivers are scarlet with migrating salmon when the peak of the spawning run passes. The best runs are found in rivers having lakes suitable for spawning in their watersheds, like the Iliamna River and its fjordlike lake, and the Adams River at Shuswap Lake in British Columbia.

This lake-oriented spawning has also been observed in Asian waters, with sixty-three percent of the spawning in vast watersheds like the Ozernaya Basin occurring in Siberian lakes.

These migrating fish are four to six years old. Extensive research on the Fraser fishery in British Columbia indicates that more than a million Sockeyes reach Shu-

swap Lake, most arriving during a single week in late summer. This migration travels 300 miles against the heavy currents of the Fraser in only eighteen days, covering fifteen to twenty miles a day.

Females form the redds while the males joust and quarrel for position. Finally they settle deep into the nest, and the males settle close and slightly below them. Their gentle undulations accelerate into sudden wild vibrations, and both fish thrust themselves forward over the redd. Eggs and milt are extruded into the gravel, and about ninety-eight percent of the *ova* are fertilized. After spawning, the females move upstream and start another redd, covering the freshly laid eggs and milt. Spawning may last through five to eight separate nests until the fish are spent.

The female covers its final nest before it slips back downstream. The smooth current of the river polishes its bed until the redds are secure under more than a foot of gravel. Other fish follow and spawn in the same currents. Mortality in the redds can range from twenty-eight to more than ninety percent. The eggs hatch deep in winter, and the tiny *alevins* emerge. Birds, sculpins, carnivorous insect larvae, and other fish exact a fearful toll; females can lay as many as 3,000 eggs, but as few as thirty reach fingerling size.

Although most fishermen catch fresh-run Sockeyes while they are still bright from the sea, fall big-game hunters fishing the rivers of Alaska and British Columbia have begun to take enough Sockeyes on flies meant for rainbows and grayling that anglers are beginning to think fishermen may have overlooked some first-rate sport.

MALE SOCKEYE

Oncorhynchus nerka ♂

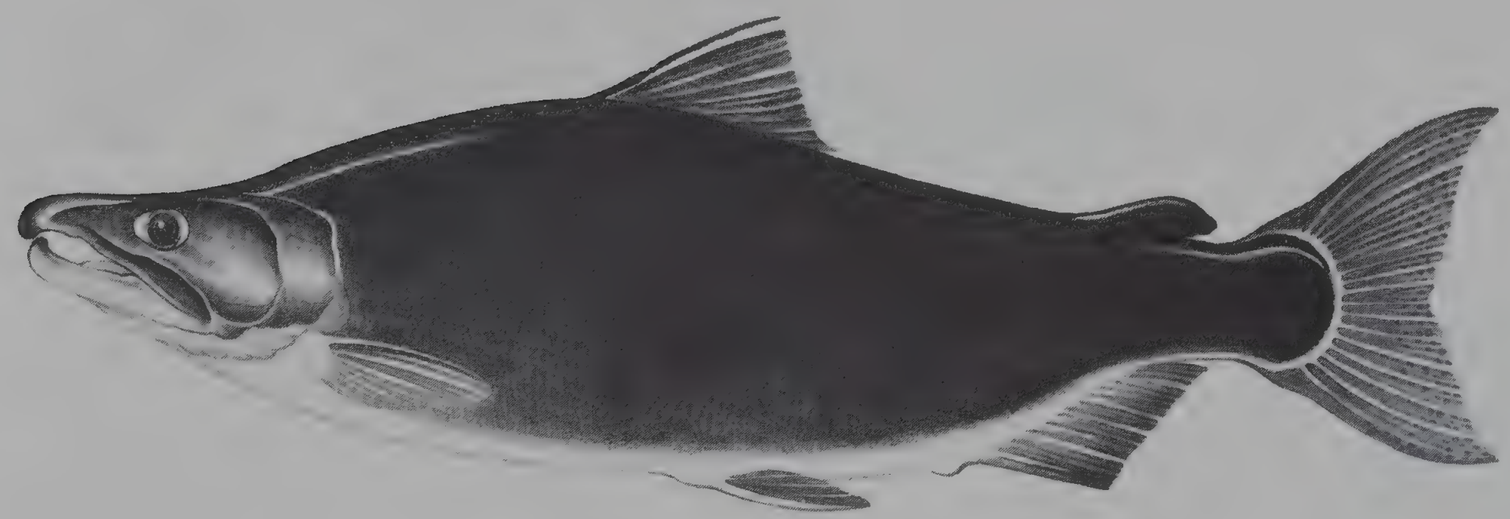


Plate 16

Male Sockeyes develop huge jaw structures and distinctly humped backs when they reach the spawning areas. Their heads and tails become a rich olive with dark spottings on the caudal structure and an almost black upper jaw above a whitish kype. Males outnumber females over the spawning redds, snapping their hooked jaws and fierce teeth in the ritual jousting of their species. Their quarrels are fought in rolling and swirling across the shallows until the defending male has traveled too far from

its redd, and breaks off to return before a third male can occupy the waiting female and her half-complete nest.

The males are so bright that the bed of a river can literally change color, from the ochre of sun-washed gravel to the steely granite of its stones, to the writhing of countless scarlet bodies and the olive accents of their heads.

There is something ancient and compelling about their arrival at Shuswap deep in British Columbia. The fish lie in the pools below the lake, turning the river rust-colored with their presence, waiting for the changes working deep in their bodies. And finally when they are ripe, they cross the gravel bar from the dark waters of the lake, backs out of the current and threshing upstream.

The pugnacious males are easily caught when they are defending their territorial rights. Fish that tumble and seize a rival male, shaking like angry bulldogs with their ferocity, are easily teased into attacking an intruding bucktail or colorful spoon. It is perhaps wrong to disturb such fish, paired and building a redd in their natal gravel, after an odyssey of thousands of miles in their rivers and the sea.

It was Atlantic salmon that the celebrated Sparse Grey Hackle spoke about some years ago at lunch in New York, but it might have been schooling Sockeyes blindly defending their mates.

Salmon are in the river for love, Sparse smiled owlishly behind his steel-rimmed spectacles, *and I can't disturb them then!*

HUCHEN

Hucho hucho♀

Plate 17

Huchen are greatly prized among anglers who live in the Alpine headwaters of the Danube, since they are shy and grow to prodigious size and are almost legendary for their fighting qualities. Specimens are occasionally taken in lakes that lie in the Danube drainage system, but the Huchen is primarily a fish of powerful currents.

Its configuration is similar to its relative, the better known Atlantic salmon, except that its body is somewhat thinner and more cylindrical, and its dorsal fin is set farther back.

Huchen are usually brown to olive green, and are often mistaken for giant brown trout. During spawning they may achieve a dull reddish cast, and their bodies are covered with minute black spots. Huchen have relatively small scales, with between 180 to 200 scales along the lateral line. The fish have from four to eight hooked teeth in a transverse row along the rear margin of the upper vomer structure, while the principal vomerine shaft is toothless. There are fourteen to sixteen gillrakers on the first arch.

Most Huchen are between two and four feet in length. Fish as large as 115 pounds have been recorded, but the average is between five and ten pounds.

Growth rates are high among Huchen once the fish reach a length of about ten inches. Huchen then stop feeding on insects and concentrate on baitfish. The fish often grow between two and four pounds a year. The growth rates are more rapid in older fish, and a fifteen-year-old Huchen can reach four feet in length.

Some ichthyologists argue that the Huchen is a landlocked salmon with its roots in the primordial species of the Black Sea. Its existence and its morphological parallels with the Atlantic salmon indicate the possibility of a common ancestor in ancient times, and later changes in temperature and salinity that eradicated the anadromous strain from the Danubian seas.

Huchen have proved difficult to breed in captivity. The water must be absolutely pure, since the eggs require high oxygenation, and the fingerlings do not thrive without live food. The fish are relatively large by hatchery standards, and their pisciculture rather difficult and uneconomical. Limited temperature and oxygen tolerances make the fry difficult to ship.

The Huchen is prized in Germany, Austria, Czechoslovakia, Hungary, Bulgaria, and Yugoslavia, just as salmon are prized in northern Europe. Its status became clear to me one spring morning near Fischen-im-Allgau when a miller admired a six-pound rainbow I had taken on a nymph from his millrace. He took me down to his pantry and showed me a fresh forty-pounder hanging from a rafter.

Six-pound trout are nice–he smiled and stared out across the valley to the river–*but a Huchen is something royal!*

TAIMEN

Hucho taimen♂

Taimen are probably the largest salmon in the world, although relatively little is known of their sporting potential. They are closely parallel to the Danubian species, and are found in the north-flowing rivers of Russia from the Pechora below Novaya Zemlya to the Amur Basin on the Sea of Okhotsk. The species is also found in the extensive watershed of the Volga, which drains into the Caspian Sea.

The fish are often quite large, with recorded specimens of as much as 150

Plate 18

pounds. Their configuration is similar to the related Huchen, except for a dorsal set even farther back along the body and a sharply tapered head.

The Taimen has 180 to 220 scales along the lateral line, with four to eight hooked teeth on the upper vomer and no teeth on the vomerine shaft. It is olive brown with tiny spots and orangish fins. The scales are relatively small. Its coloring is more intense in spawning time, with an orange cast and orangish caudal and anal fins. There are eleven or twelve gillrakers on the first arch, and its rate of growth can reach as much as four pounds a year.

Spawning occurs in the spring, when the fish travel up their rivers and enter the smallest tributaries to deposit eggs in beds of gravel having a swift current. The Taimen is particularly fertile, with a ripe female laying between 10,000 and 35,000 eggs. Following the egg-laying cycle, the Taimen begins to feed intensively again on fish such as roach, dace, grayling, char, and lenok. Whitefish and salamanders and frogs are also important foods, although small mammals and waterfowl and birds have occasionally been recorded from the intestines of the Taimen.

There is no record of their movement into estuarine or coastal waters, although they may enter the relatively fresh water of the Caspian Sea. The size and fighting power of this species, and its distribution through the wilderness rivers of Siberia, make the Taimen an enigma for anglers with a sense of adventure.

MANCHURIAN SALMON

Hucho blackistoni ♀

These graceful fish are related to the Huchen of the Danube region, as well as the powerful Taimen of Siberia. The species is not as large as its sister Huchen, reaching a maximum of about fifteen pounds. It is not migratory like other salmon, and is found in the cold rivers of Korea and Manchuria. Little is known of its numbers and sporting qualities.

Like the other species of the genus *Hucho,* this Manchurian fish is perhaps a residual trace of a common ancestor among salmon, landlocked when the Yellow Sea became too warm or too saline deep in marine prehistory. It is common in the Yalu and Cholo watersheds.

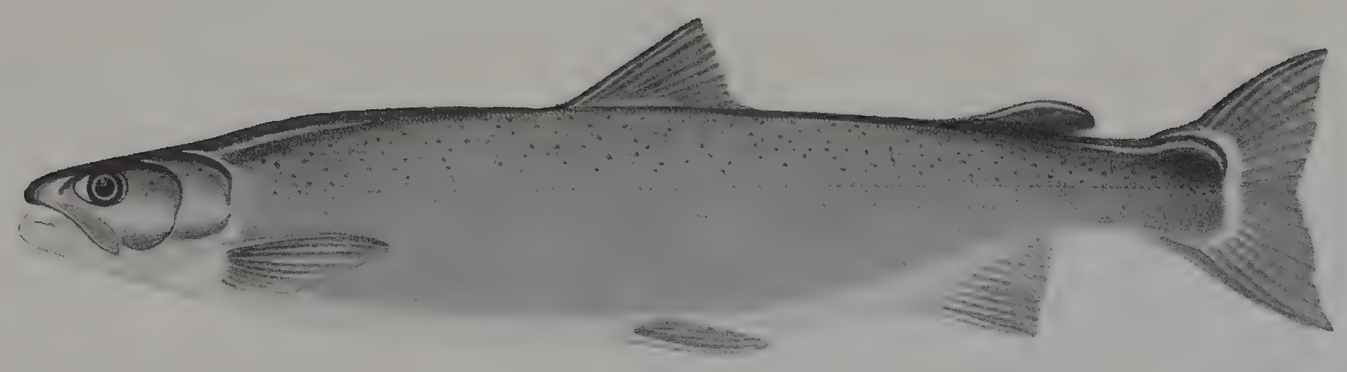


Plate 19

Hucho blackistoni is pewter-colored and spotted with tiny markings. Its fins are dark. It has tiny scales that number between 170 to 210 along the lateral line. There are twelve to fourteen gillrakers on the primary arch. The configuration is similar to that of the other *Hucho* species except for its slenderness and grace.

Spawning occurs in the Asian spring, when the Manchurian salmon move into the headwaters and feeder creeks. Their hardiness and fecundity are good, and mature females can oviposit as many as 20,000 eggs. During spawning the fish are sometimes touched with an orangish rosy cast, not unlike the flush of color on a sea-run rainbow in the Americas.

Although the flesh of the genus *Hucho* is excellent, it has limited commercial importance in much of its range. Most commercial catches are made with hook-and-line, since both its wariness and its habitat make it a difficult fish to capture in nets and seines. It has seldom been fished by anglers.

KURILE SALMON

Hucho perryi ♀

Unlike other species of the *Hucho* genus, the Kurile salmon are anadromous fish entering the rivers that flow into the Sea of Japan. They are clearly Huchen, but are sea-bright like other salmon fresh from salt water. The spawning habits are similar to those of the Pink and Chum salmon of the *Oncorhynchus* species, in the sense that they often spawn almost in the brackish currents or the lower reaches of their parent rivers. Their relatively minor migrations within the Sea of Japan and their estuarine behavior resemble those of sea trout.

Plate 20

Once in fresh water, the Kurile salmon regain their olive coloring and tiny covering of dark spots. Courtship and spawning are similar to the behavior of other salmon. The females shape the redds and the eggs and milt are covered with gravel.

The tiny *alevins* hatch in early summer and live on their delicate yolk sacs until they abandon the nests. They live on tiny crustaceans and nymphal foods almost as soon as they wriggle free of their natal gravel. Unlike other Huchen forms, these fish remain in their fingerling schools as they drop back to the sea and migrate in their marine feeding grounds. Their growth at sea is also rapid, although their maximum size is less than forty inches and twenty-odd pounds.

Like the other Huchen ecotypes, Kurile salmon have relatively tiny scales numbering between 180 and 200 along the lateral line. There are fourteen to sixteen gillrakers. The vomerine tooth patterns are also found in its sister species.

Huchen are justly famous for their stubborn fight, which consists of powerful lunging runs at great speed. The battle continues once these runs are countered, with a series of stubborn bulldoggings deep into the pool. The sport of the only sea-run Huchen is a challenge for any angler.

BAIKAL SALMON

Brachymystax lenok ♀

Plate 21

This unique fish occupies a similar morphological relationship to the salmon that the grayling has with trout. There are biologists who believe *Brachymystax lenok* is an ecotype lying between the salmon, the trout, and the grayling. It differs principally from its sister *Salmonidae* in that it has a smaller mouth and moderately large dorsal fin for its size and configuration.

Its range is more extensive than Lake Baikal and its tributary waters in Siberia. Baikal salmon are also found in other Siberian rivers from the Kara Sea to the barren mountain rivers of Chukchi. The species is particularly numerous in rivers like the Kolyma watershed, draining into the Arctic, and the Amur, which runs through both Manchuria and Russia into the Sea of Okhotsk. Some populations are found as far west as the River Ob and as far southeast as the Yalu.

The species lives in the swift foothill reaches of its rivers. It is not anadromous

and is not known to enter saline waters. Most specimens range from one to eight pounds, although fish of as much as fifteen pounds have been recorded.

Spawning occurs in the spring. There are often two distinct runs that migrate upstream in May and June. Spawning occurs in streams tributary to Baikal from late May until early July. Specimens collected in the Angara watershed were spawning well into July. The females lay between 3,000 and 7,000 eggs.

Like the true salmon, *Brachymystax lenok* often dies after it has finished spawning. Mortality is greater among males than females, although many fish apparently survive to spawn a second time.

The diet of the Baikal salmon consists principally of small crustaceans, mayflies, and caddisflies. Small baitfish form a part of its food. Although it is most often harvested for food in its local habitats, with traps and weirs and net systems, it is obviously a fish of fly-fishing potential.

SEBAGO SALMON

Salmo sebago ♀

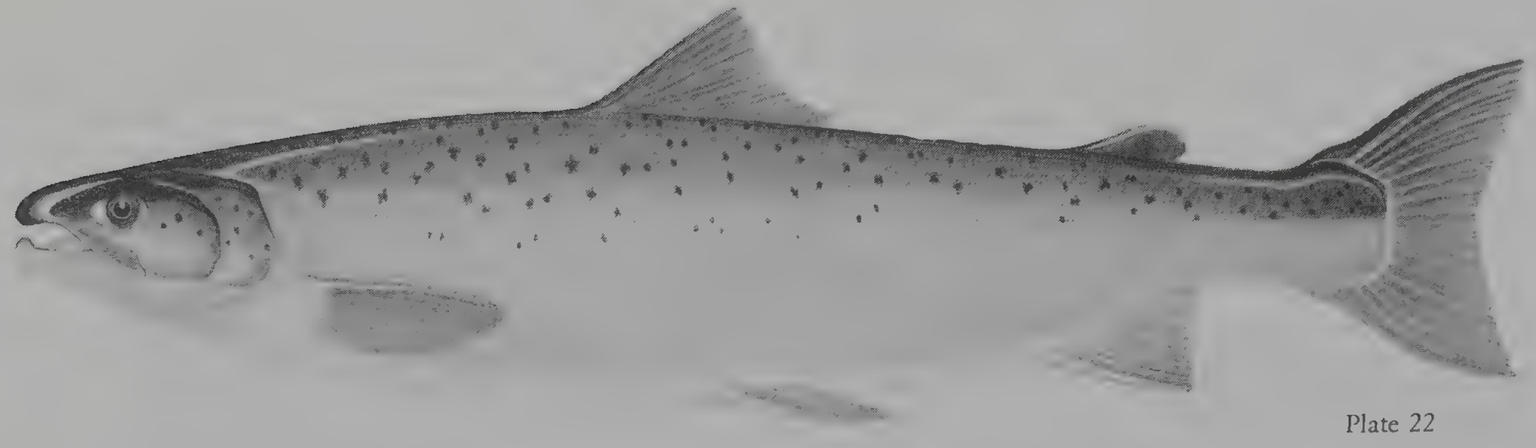


Plate 22

This famous species of landlocked salmon was first classified from Lake Sebago in Maine, although it was once found in many watersheds and lakes like Ontario and Champlain. It has the same structural and taxonometric characteristics as the anadromous Atlantic salmon, and *Salmo salar sebago* is its full scientific name.

The geological upheavals that isolated *Salmo sebago* in its native watersheds are lost in prehistory. Separated from access to the sea, landlocked salmon are deprived of rich sources of food and do not grow as large as their sea-run cousins. Most landlocks taken in Maine are two to three pounds these days, although the record of twenty-two and a half pounds was caught in Sebago Lake in 1907.

Spawning occurs in the autumn, with fish gathering in the tributary inlets and outlets as early as September. The landlocks are paired and spawning in the middle of October, and their egg laying continues until early December.

Salmon spawn well in the inlets and outlets of lakes having the proper currents and bottom conditions. The redds are constructed by the females, just as the parent Atlantic salmon engage in their spawning, until the female extrudes her eggs in a

cloud of milt from the shuddering male. The eggs settle into the shallow depression of the redds and are covered when the next nest is begun.

Landlocks are structurally identical to their sea-run relatives in the Atlantic. There are eight to ten rays in the anal fin. The scale-count along the lateral line is 120 to 130, and there are ten to twelve scales from the line to the adipose. The dorsal fin has ten to twelve rays. The fish have eighteen to twenty gillrakers, and fifty to eighty pyloric caeca. They are a handsome species.

Salmon fry feed extensively on aquatic insects and plankton and tiny crustacea in their maiden rivers and lakes, but after their first year, they turn to baitfish like alewives and sticklebacks and smelts. Growth is relatively slow in their northern latitudes and acid habitat, with about fifteen inches after three years and only twenty-five inches after eight years.

The best sport in the United States is found in the Maine lakes and rivers of their original range. Sebago Lake and the Penobscot watershed and the Kennebago are prime spots, although the best Sebago fishing is probably in Argentina. Maine landlocks were introduced into the Traful watershed in the Argentine in 1904, where rich rivers and fantastic supplies of freshwater crabs and baitfish resulted in explosive growth. Other landlocks have since been introduced into Lago Situacion, Lago Currhue, and Lago Meliquina in upper Patagonia. The portrait of *Salmo sebago* in this portfolio was made from an eleven-pound female taken from the Pool of Plenty on the classic Traful in Argentina.

OUANANICHE

Salmo ouananiche♀

Plate 23

The second landlocked salmon species is the legendary Ouananiche from the wilderness of Quebec. Although some strains in the subarctic have access to the sea, they are clearly non-migratory and remain in the rivers. Ouananiche are usually smaller than Sebago landlocks farther south.

Like the landlocked salmon of Maine, the Canadian Ouananiche is taxonometrically identical to its parent anadromous species. Its true nomenclature is *Salmo salar ouananiche,* and its morphology closely parallels the Atlantic salmon.

Ouananiche are often somewhat more strongly marked than either the Atlantic

salmon or its landlocked subspecies from Maine. The fins and tail are proportionately larger than those of other landlocks, perhaps resulting from the rapids and strong currents typical of its native watersheds.

Structurally the species has 120 to 130 scales along its lateral line, and ten to twelve scales below its adipose fin. The vomerine bone has a transverse series of teeth on its anterior margin, and a single series on its primary shaft. There are ten to twelve rays in its dorsal fin, and eight to ten anal rays. The fish have eighteen to twenty gillrakers and fifty to eighty pyloric caeca.

Ouananiche average below two pounds, and a six-pound fish is unusual, but ten- to twelve-pound trophies are possible. The fish take flies eagerly and are justly famous for their wild cartwheeling fight when hooked.

The best Ouananiche fishing is found in the subarctic latitudes below the mist-shrouded reaches of Ungava Bay. It is a world of brief caribou-moss summers and scrub forests and tumbling wilderness rivers that connect a world of glacial lakes. Ouananiche addicts can be found exploring that world with canoes and float-planes in June and September, hoping for that twelve-pound trophy.

GOTLAND SALMON

Salmo wenerensis ♀

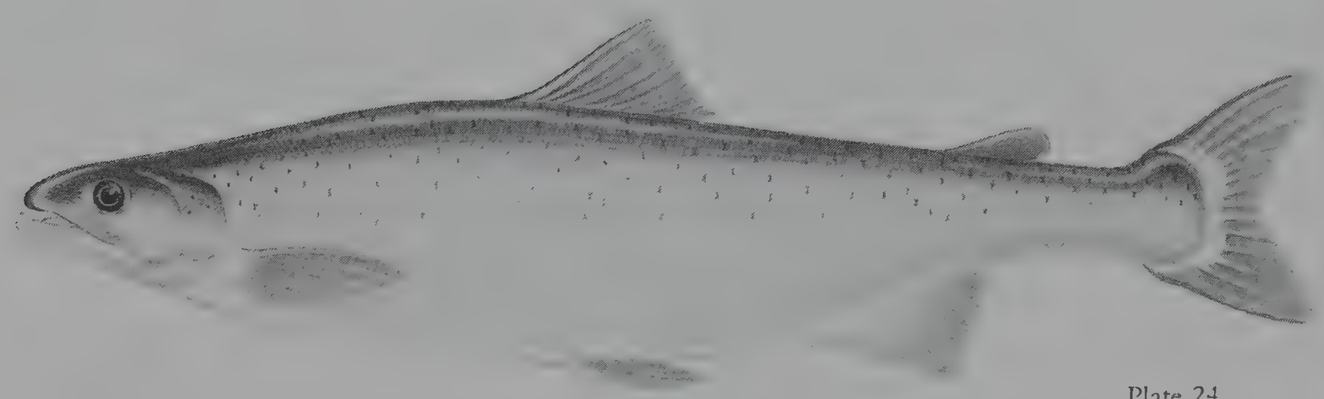


Plate 24

This landlocked form of the Atlantic salmon is found principally in Lake Wener and other large lakes of Sweden. It is not migratory and can attain weights to fifteen and twenty pounds, although it spawns in the Gotha in the fall and summers in the depths of the lake. It is a highly prized species, with orangish yellow flesh that is somewhat paler than the migratory salmon. Structurally, the Gotland salmon is identical to the Atlantic salmon, and the designation *Salmo salar wenerensis* is the full nomenclature for this subspecies.

The vomerine structure is triangular, with a transverse series of teeth across its anterior margin, and a single series on its principal shaft. There are thirteen scales above the lateral line, with eighteen to twenty gillrakers on the primary row. There are 120 to 130 scales along the lateral line and eight to twelve anal and dorsal rays. The fish is gracefully proportioned with a slender tail structure and caudal fin.

Its principal foods are plankton and insects in the early years when the fingerlings migrate from their river spawning areas to the lakes. Later the Gotland salmon turn to crustacea and baitfish, and grow so rapidly that six- to eight-pound fish are common. The species is a first-rate sporting fish, although most Swedish anglers prefer trolling and spinning to fly-fishing.

BLEGE

Salmo dahlensis♀

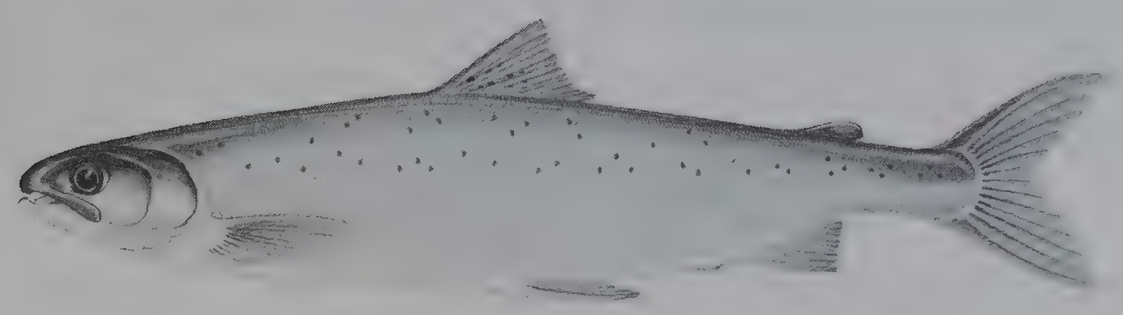


Plate 25

The graceful little Blege is a dwarf form of Atlantic salmon landlocked in the Bygglandsfjord watershed of Setesdal in southern Norway. The species is isolated in the River Otra by the waterfalls at Vigelandsfoss, the limit of migration by adult anadromous salmon in the river.

The Blege was first described by the distinguished Norwegian salmon biologist Knut Dahl, whose many books on salmon and sea trout are standard works in their field. Dahl did not give the Blege a taxonometric name, merely pointing to its morphology in common with the Atlantic salmon. However, it seems appropriate to designate the handsome little Blege with the name *Salmo salar dahlensis* as a memorial to Dahl and his work.

Blege are found in the Otra watershed over a distance of about seventy-five miles. The species is most common in the lakes at Bygglandsfjord and Araksfjord, and in the Setesdal River as far as Hallandsfoss for a distance of thirty-odd miles.

Dahl recorded his first encounter with the Blege, and his first observation was that it was an exceptionally large smolt of the anadromous Atlantic salmon. The fish is slender and graceful, with a deeply forked tail and large eye above a delicate head and mouth structure. Faint traces of parr markings and red spots sometimes show through its silvery coat and scattered black spots. Scale counts above the lateral line varied between eleven and fourteen, confirming a relationship with the parent adult salmon. The caudal peduncle and anal fin are approximately the same length, and have salmonlike proportions.

The diet of the Blege is concentrated on plankton forms, particularly in the lakes in its native watershed. The major form discovered in stomach autopsies performed on the Blege was the minute crustacean of the *Bosmina* genus, with a scattering of *Chironomidae* and other insects. However, the principal diet of the Blege is plankton.

Blege spawn both in the rivers and the lakes. However, hydroelectric demands on the Bygglandsfjord water levels have seriously impaired egg fertility among lake spawners in the drainage system. Some lake spawning still occurs in the Araksfjord and Kilefjord.

Since the Blege lives above waterfalls that are at least 115 feet above the present sea level, the drop presently being marked by high falls at Vigelandsfoss and Hunsfoss as well as normal river flowages, the Blege must have been isolated in some epoch when those falls were only part of the coastal seas. Geologists estimate that the sea was about 150 feet higher than its present level at the close of the last glacial epoch, and as the climate warmed to suit the ecology of salmon, the sea would have been about 130 feet deeper than its modern elevation. Both Vigelandsfoss and Hunsfoss would have been under water, and the anadromous ancestor of both the Blege and the salmon would have entered freely.

Similar dwarf salmon are found landlocked in the headwaters of the Niddelv and at Arendal above Trondheim. There is a larger form of Blege found in the Namsen that clearly has access to the sea but apparently does not leave the river. Blege of the Namsen average about two pounds and offer excellent sport fished with small salmon and sea trout flies in August.

KARELIAN SALMON

Salmo karelius ♂

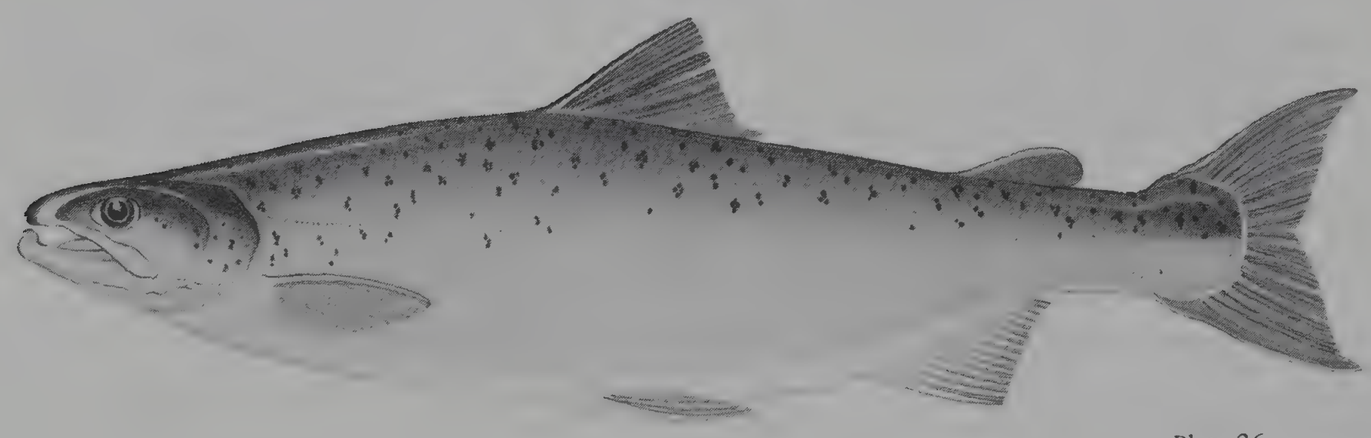


Plate 26

Karelian salmon are found in the forested plains and plateaus of Russia above the Gulf of Finland. Like the landlocked salmon of Gotland, this species is most common in the lakes above Leningrad, particularly the vast Ladoga that reaches from the drainage basins of the Svir and Volkhov into the pine-covered hills of Finland.

Like the Blege in southern Norway, the salmon of Karelia turn to plankton and *chironomidae* when they are first hatched in the rivers feeding Ladoga and Lake Onega. Riverine spawning of the species occurs in the River Neva, and in the primary tributaries of Ladoga like the Oyat, Volkhov, and Svir. Some stocks of Karelian salmon are also found in Lake Onega and in the smaller Lake Ilmen farther south.

Once the salmon migrate back into the lakes from the rivers, they turn to baitfish and tiny crustaceans and crayfish. Their growth in the lakes and in the deep currents of the Neva is relatively good, and during the golden age of Saint Petersburg, the fish averaged eight to ten pounds. Wealthy Russian gentry prized them highly as table fare, and many were kept in impoundments on their estates.

Karelian salmon are closely related to the parent Atlantic species, and *Salmo salar karelius* is their proper designation. There are 120 to 130 scales along the lateral line. The scale count from the adipose fin is ten to twelve, and there are eight to ten anal rays. There are eleven rays in the dorsal fin. The vomer bone has a transverse series of teeth on its anterior margin, with a single series on its shaft, and there are eighteen to twenty gillrakers on the primary arch.

Little is known concerning the present stocks of Karelian salmon, since most Russian ichthyology is focused upon species of fish better suited to larger commercial harvests, and sport fishing is secondary.

OKHOTSK SALMON

Salmo peshinensis♀

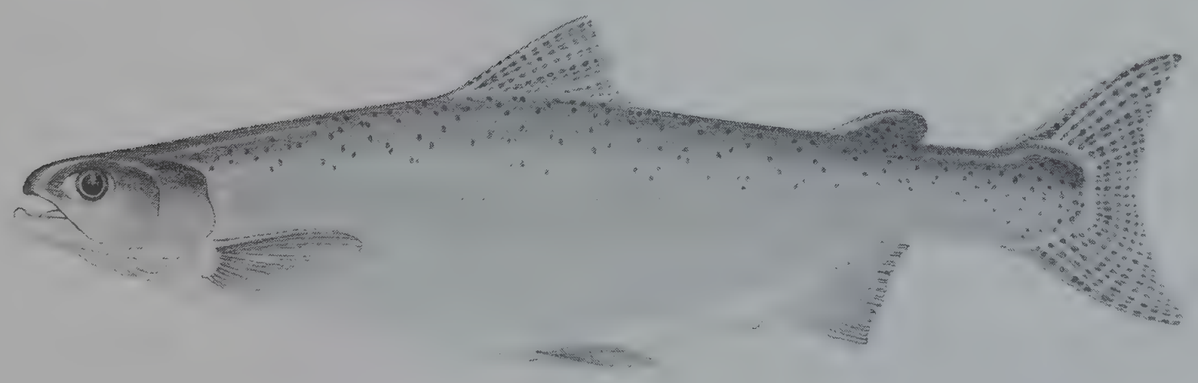


Plate 27

This little known species is the only true salmon of the genus *Salmo* found in the Pacific watersheds. Like the Japanese Masu, the Okhotsk salmon is considered a close link to the Pacific trouts of the same genus. It was classified from a single watershed, which includes the tumbling Penzhina, and its Krehbet and Oklan tributaries. These rivers enter the Sea of Okhotsk through the narrow Penzhinskaya Guba Sound, which lies at the foot of the Kamchatka Peninsula.

Okhotsk salmon have been reported in other rivers on the Asian coast as far south as the Amur, but these specimens are unconfirmed and the species is considered relatively rare. It is often found with riverine and estuarine forms of *Salmo mykiss,* which is similar to the American cutthroat.

Salmo peshinensis is a relatively small species of salmon, averaging about one to two pounds, although fish to eight pounds have been recorded. The Okhotsk salmon is considered unimportant from a commercial standpoint, but its rarity alone makes it intriguing to salmon fishers.

The species is also interesting in its spring egg laying. It is the only *Salmo* of its genus that is not a fall spawner, and according to Russian biologists like Krogius and Shishov, its opposite-season oviposition is perhaps a result of competition with its more numerous Pacific cousins. Thousands of *Oncorhynchus* salmon dominate the available acreage of suitable gravel in the autumn, and only those isolated trace populations that adapted to spring spawning conditions, when the Asian rivers are empty of mating salmon, have survived as the Okhotsk species.

DALMATIAN SALMON

Salmo obtusirostris ♀

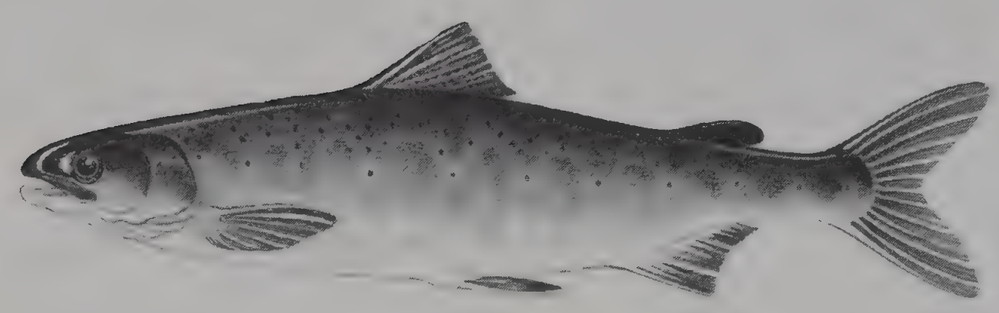


Plate 28

The presence of this species of dwarf salmon in the mountains of Dalmatia, and once to a lesser degree in cold streams draining the Abruzzi in Italy, points to the existence of salmon in the Adriatic in some past glacial age. It reaches a maximum size of twelve to fifteen inches in the rivers of Yugoslavia, where it remains relatively abundant, and it was even once found in the headwaters of the Tiber.

It is similar to the brown trout, although its fewer scales show a distinct relationship to the Atlantic salmon. The tail structure has the graceful proportions found in salmon smolts and parr, and the tail itself is distinctly forked.

The vomerine teeth occur in two parallel series, with a transverse row of six teeth in front. It has fifteen to eighteen long gillrakers and twelve to fourteen scales above the lateral line. There are approximately 110 to 120 scales along the lateral line, and eight or nine rays in the anal fin.

The coloring is rather like a large parr of the Atlantic salmon, with pale ochreous browns and bright red spots. Some specimens show distinct parr markings, and in waters having good supplies of crustacea and plankton, the fish may have a silvery cast and spotting patterns reminiscent of salmon or sea trout. The dorsal fin is rather high and relatively long in its proportions, the last ray being about half the length of the first. It is a graceful and exquisitely colored species.

Dalmatian salmon are still found in Yugoslavian rivers like the Zermagna and Veryca, although they are all but extinct in the mountain rivers of Italy. Their existence in the Tiber would indicate a primordial form of salmon in the entire Mediterranean, in some distant epoch before the warming seas isolated them in the mountain rivers.

KURA SALMON

Salmo caspius ♂

This species is a puzzle to fishery biologists, since they are divided on its status. Specimens as large as 115 pounds have been recorded, their very size discounting the opinions that classify *Salmo caspius* among the trout species.

Such weights make this species the largest of its genus, even larger than the maximum weights recorded for Atlantic salmon. Its taxonometric position is unclear, perhaps because its morphology has been confused with anadromous trout forms also common in the Caspian Sea. Although its presence was recorded in the Volga in the seventeenth century, the species is now found principally on the southwest coast of the Caspian. Its primary spawning grounds lie in the rivers that drain the Caucasian Ridge, particularly in the Terek and the Kura.

Plate 29

Kura specimens lay between 15,000 and 30,000 eggs in the fall and winter. Autumn spawners are relatively small and form their redds within fifty to seventy miles of the estuary, while the biggest winter fish ascended as much as 400 miles to Tiflis before the reservoir at Yevlakh was built. Spawning fish are found from September to February, with the later oviposition occurring in the lower and warmer reaches of river. Spawning behavior parallels that of the Atlantic salmon.

Spawning occurs after four to seven years in the Caspian, with ten to twenty percent of the smolts descending the river in their first year. These fish apparently form the smaller fall spawners in the Kura watershed, while the larger winter fish come from the two-year smolts. There are also dwarf males, like those of the other salmon ecotypes, that apparently do not migrate into salt water. The Kura salmon are found in sufficient stocks to form a commercial fishery.

Berg and Derzhavin believe *Salmo caspius* shares a common ancestor with the Atlantic salmon, perhaps in some primordial epoch when the Eurasian seas were joined and the Mediterranean was cold enough to support salmon ecotypes. The specimen used for this portfolio is surprisingly like the Atlantic salmon in its male spawning colors, but is a specimen from the Kura strain.

ATLANTIC SALMON

Salmo salar ♂

Atlantic salmon are the principal sporting fish of the world. Dame Juliana Berners found them regal in her fifteenth-century *Treatyse on Fysshynge with an Angle,* and Walton crowned them his king of fishes in 1653. The species is unequaled for its mixture of tradition, its great physical beauty, the elegance of its tackle, and its sporting qualities. There has never been a serious pretender to the throne.

The species was once found in all of the principal rivers from the Douro in Portugal north to the Pechora on the Arctic coast of Russia. Huge stocks of salmon once migrated into the Thames and the Seine and the Rhine as far as the falls above Lake Constance. Salmon are still found in most of the Baltic rivers, including several in Poland and eastern Germany. The species is found in most Norwegian rivers and in many rivers of the British isles. It is particularly abundant in Iceland, although only strays enter the rivers of Greenland, and most salmon reported from its glacier-silt watersheds are really sea-run Arctic char.

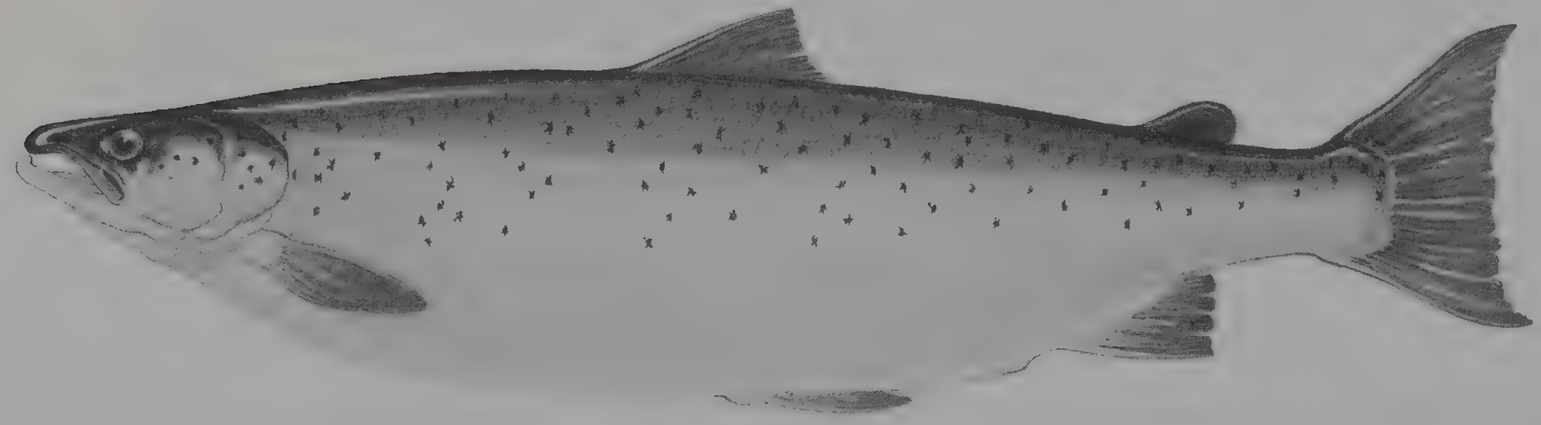


Plate 30

Canadian and American rivers once held huge stocks of salmon. There are early nineteenth-century drawings of Atlantic salmon harvested from the Delaware at Easton and Trenton, which would indicate that *Salmo salar* populated most of our eastern rivers north of Philadelphia. The Connecticut and Merrimack were once among the finest Atlantic salmon fisheries in the world, and the first salmon of the season from the Bangor Pool on the Penobscot was traditionally sent to the White House in Washington.

Salmon thronged all of the Canadian rivers from the border north across the Saint Lawrence to the mountainous coasts of Quebec and the barren Labrador. The rivers of Anticosti and Newfoundland were rich with fish. Most fisheries experts long believed their range was limited to the east-flowing rivers below Cape Chidley. However, development of vast ironfields in the interior led to extensive exploration of the Ungava highlands. Many of these modern prospectors used helicopters and floatplanes, and along with new mineral riches they found *Salmo salar* in great numbers. These

fish enter the north-flowing rivers that feed Ungava Bay during August and September, and are particularly numerous in huge subarctic rivers like the Koksoak, the George, and the River of Whales.

Dams and industry and timber harvests that warmed the rivers have decimated the Atlantic salmon. Its modern range no longer includes the major rivers of the European continent, and the once great runs that entered the rivers of France and Germany and Portugal are gone. The rivers of Spain no longer offer first-rate sport, and the species was eliminated entirely from American waters until partial restoration of several minor rivers in Maine. Modern pelagic fishing techniques now threaten the species with extinction unless treaties can be forged to protect them from high-seas exploitation off Greenland and northern Norway.

The morphology of *Salmo salar* includes slenderness of the caudal peduncle, ten to thirteen scales between the adipose fin and the lateral line, ten to twelve rays in the dorsal fin, between 120 to 130 lateral scales, and eight to eleven anal rays. The caudal structure is clearly forked, particularly in smaller specimens, and there are fifty to eighty pyloric caeca. There are relatively few teeth on the vomerine structure.

The salmon in this portfolio is a cockfish killed by the author at the Velleniva Pool on the Alta. It was taken on a trout rod with a 2/0 hairwing Torrish, two hours after the midnight lunch on the ledges above the pool, but it was on another Norwegian river that I best heard our reverence for the species expressed in words.

I love the salmon and fishing for salmon, said the riverkeeper on the storied Driva, *but I love them so much that I don't really want to catch them anymore.*